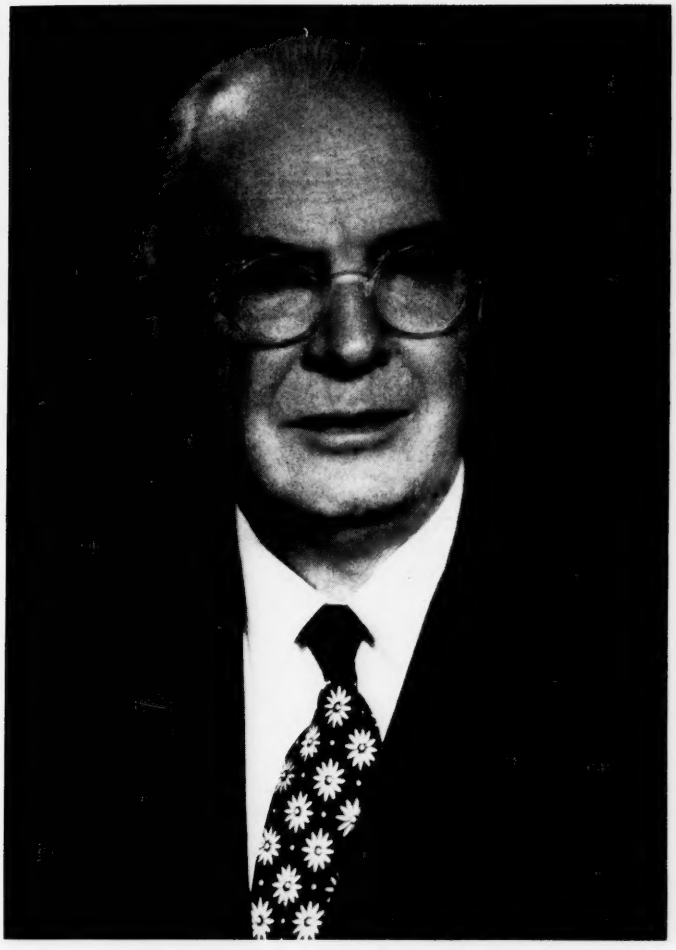
Metals Review



December 1959

Joseph V. Emmons
Cleveland Twist Drill Co.
(See Article, Page 4)

METALS FOR NUCLEAR REACTORS

They were blending calcium, dry zinc chloride, and dry thorium flouride. One of them noticed dust and gas escaping from an open mixer vent. He closed the vent and started the mixer. After a rumbling noise, a scorching burst of flame spewed for 40 feet. Two men dead. Six injured. Cause: undetermined.

This is but one result of the "unknown" factor in today's search for metals for nuclear reactors—metals for what must be understood as a vital technology.

The man who works with these metals is not too unlike any metals engineer in the industry. He is a lab technician, a physicist or a test engineer much like any other. But what makes his job extraordinary is fear. Not fear of "Cause: undetermined"; fear of too little progress and insufficient information in an area so vital to the national economy.

The American Society for Metals has published a new volume which will introduce to you this struggle for progress and understanding in the development of metals for nuclear reactors . . . that's the title, "Metals for Nuclear Reactors". It talks about zirconium, thorium, uranium, cadmium—nuclear metals. The words toxic and pyrophoric are common.

W. A. Maxwell, technical editor of "Metals for Nuclear Reactors", describes the tone of this book in Chapter 2, which he personally wrote: "In view of the limited material situation, much present designing is done in desperation. The reason for this is quite simple. To build a reactor at all, available materials must be utilized. Available materials, however, are often barely adequate for reactor environments; improving these materials offers a challenging future . . ."

Do not mistake this book as a text for metals engineers in the nuclear field only. It should be read by any man associated with the myriad of metals problems in today's era of unprecedented progress. A large number of problems common to other metals interests are intensified in the reactor field. Corrosion difficulties are certainly encountered in every aspect of materials work, but reactor corrosion claims some of the most rigorous conditions and tightest specifications. As another example, the development of high temperature alloys for jet engine turbine blades was one of the most important developments of recent years, and while similar alloys are badly needed for reactors, the metals engineer will have to do his work with a different and unpromising set of elements. You will be introduced to the use of exotic materials which only days ago were textbook curiosities.

Core of a homogeneous research reactor built by Atomics International for Armour Research Foundation. Sphere contains a solution of uranium salts and is cooled by the coil. Photo reprinted from ASM's new book, "Metals for Nuclear Reactors".

"Metals for Nuclear Reactors" is an introduction to an imminently brilliant technology . . . an accounting of where we are today in the development of nuclear power . . . a documentation of how well we are combating the austere, uncompromising fact that as the demand for electrical power is going up, the supply of coal and oil is going down. Don't miss reading it. You will know just where we stand and what we have yet to do.

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American Society for Metals
Metals Park, Dept. MR-12
Novelty, Ohio

RE: "Metals for Nuclear Reactors"—6 Chapters—117 Pages—Red Cloth Cover—W. A. Maxwell, Technical Editor (7 Authors)—Illustrated—6 x 9—Contains Appendix (Available films and recommended reading)—$8.00, postage paid.

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Metals Review

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Betty A. Bryan, Editor
A. P. Ford, Sales Manager
G. H. Loughner, Production Manager

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DISTRICT OFFICES
William J. Hilty
Rodney W. Cramer
Metals Park, Novelty, Ohio
JOrdan 4-2271

John B. Verrier, Jr.
Fred Stanley
342 Madison Ave., Room 1228
New York 17, N. Y.
OXford 7-2667

Donald J. Walter
53 West Jackson Blvd.
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WAbash 2-7822

William F. Mills
(Whaley-Simpson Co.)
6608 Selma Ave.
Los Angeles 28, Calif.
HOllywood 3-7157

Gordon Simpson
(Whaley-Simpson Co.)
700 Montgomery St.
San Francisco 11, Calif.
SUtter 1-4583

•

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CONTENTS

Important Lectures

Departments

Joseph Emmons to Retire From Cleveland Twist Drill Co.

Joseph V. Emmons will retire Dec. 31 as metallurgical and research consultant, Cleveland Twist Drill Co. During his association with Cleveland Twist Drill, Mr. Emmons saw many of his dreams fulfilled, not the least of which was the celebration in 1959 of his 50th year anniversary with the Company.

Mr. Emmons received an A.B. degree from the National Normal University in Lebanon, Ohio, and then entered Case School of Applied Science (now Case Institute of Technology) for special work in chemistry. After leaving Case he was employed for a short time as night chemist in the blast furnace department of the Upson Nut Co., now a part of Republic Steel, in Cleveland. He joined Cleveland Twist Drill in 1909 as assistant chemist, and in 1910 was appointed chief chemist. In 1912 he became head of the laboratory department. A short time later he was appointed metallurgical engineer—one of the first men in Cleveland to be given this title. In 1952, Mr. Emmons was appointed director of laboratories, a position which he held until 1956 when he received his present appointment. Mr. Emmons has served as a member of the Company's Board of Directors since 1952.

Over the years, Mr. Emmons has been closely associated with the development of a number of significant advances in the metallurgical field. In 1911, he was one of the first men to develop and use the technique of microscopic study of toolsteel for research and development purposes. Later he played an important part in the development of the first twist drills to combine both the toughness of a forged product and the accuracy of a milled tool. He has also been a pioneer in the development of carbide tipped tools, and a number of patents have been received as a result of his research in this field.

Following World War I and the serious tungsten shortage which developed during that period, he initiated research into the development of a high-speed steel which would not require a high percentage of tungsten as a principal alloying element. This far-sighted research project culminated in the patenting, over ten years later, of a molybdenum-tungsten steel which proved to be the first successful molybdenum high-speed steel. The development and use of this type of high-speed steel during the 1930's made possible the continued production of high-quality cutting tools when World War II broke out, and again, more recently, after Korea, in spite of the critical shortage of tungsten which occurred on both these occasions.

In 1936, Mr. Emmons received the degree of metallurgical engineer from Case and was elected to the honorary society, Sigma Xi, for outstanding work in research. He is the author of numerous articles concerning metallurgical problems encountered in the manufacture of cutting tools, and he has also been a frequent lecturer on metallurgy in toolsteels at Case for many years. Over 25 patents have been taken out in his name. In 1940 he was selected by the National Association of Manufacturers as a "Modern Pioneer". A long-time member of the Cleveland Engineering Society, he was president of that organization in 1927-1928. He is a Fellow of the American Association for the Advancement of Science, and is also a member of the American Institute of Mining and Metallurgical Engineers, American Chemical Society, American Society for Testing Materials, British Iron and Steel Institute, and the American Society for Metals, from which he received the Henry Marion Howe Medal in 1933 for his work on molybdenum high-speed steels, and of which he was national treasurer in 1921-1922. He was an organizer and charter member of the Cleveland Chapter and Chapter Chairman in 1920.

Mr. Emmons was born Jan. 24, 1888, in North Lewisburg, Ohio. He and his wife, the former Helen King, reside in Shaker Heights, Ohio. The Emmons' have two children, Roger King Emmons, and Mrs. Betty Emmons Burkhardt, and six grandchildren.

Forestry is Mr. Emmons' principal hobby. He is a member of both the Ohio and the American Forestry Associations and is part owner of "Ohio Tree Farm 47" a 165-acre plot adjacent to his farm in Geauga County.

Mr. Emmons will continue to serve as a member of the Board of Directors of Cleveland Twist Drill after his retirement. He will also continue his activities in the metallurgical and research fields as a consultant.

Mahoning Past Chairmen Hear Jominy

Past Chairman Honored at a Meeting of the Mahoning Valley Chapter Included, From Left: H. A. Holberson, R. P. Hill, and A. H. Vaughan, and W. E. Jominy, National Secretary A.S.M., Who Spoke on "Hardenability" and K. L. Fetters, R. T. Wiandt, E. J. P. Fisher and W. R. McCrackin

Speaker: W. E. Jominy
A.S.M. National Secretary

National Secretary W. E. Jominy was guest speaker at the past chairmen's meeting of the **Mahoning Valley Chapter.** Past chairmen honored with certificates, presented by K. L. Fetters, present chairman, included R. W. Justice (1949), H. Holberson (1951), R. P. Hill (1952), E. J. P. Fisher (1953), W. R. McCrackin (1954), P. T. Kelley (1955), A. H. Vaughan (1956) and R. T. Wiandt (1957).

The 60 persons who attended the meeting heard Mr. Jominy define "Hardenability" as a physical property that determines the depth and distribution of hardness in steel and its alloys. He indicated that the most popular means of determining hardenability is by the end quench process. By knowing the end quench hardenability curve, said Mr. Jominy, it is possible to not only ascertain the hardenability of steel but, also, to substitute one steel for another to meet a given hardenability specification.

Mr. Jominy wound up his interesting talk with a question and answer period.—**Reported by Richard H. Rein for Mahoning Valley.**

Speaks on High-Temperature Corrosion

Shown at a Recent Meeting of the Los Angeles Chapter Are, From Left: Donald Clark, Past President A.S.M.; Richard P. Stemmler, Technical Chairman of the Meeting; Mr. Moran; and H. A. Curwen, chairman of the Chapter

Speaker: John J. Moran

International Nickel Co., Inc.

Los Angeles Chapter members were treated to an excellent presentation on "High-Temperature Corrosion of Metals and Alloys" by John J. Moran, Development and Research Division, International Nickel Company, Inc. This topic followed the Chapter's theme of "Problems and Procedures of Modern Metals" for this year.

Corrosion is an ever-present problem of direct and vital concern to everyone in the metalworking industry. Always troublesome and costly, it assumes even higher significance and offers greater challenges to the producers and designers of metal components when high temperatures are involved. As newer developments in industries, such as aircraft, petroleum, chemical, turbine, etc., are made, new corrosion problems are encountered.

High-temperature properties are mainly considered in terms of creep and stress rupture. However, corrosion from reactive liquids, solids and gases moves more and more into the design picture as loss of mass, contamination and embrittlement are considered.

Generally speaking, high-temperature corrosion may be described by one of four rate expressions. These are: linear, parabolic, logarithmic and asymptotic. They relate the increase in scale weight or thickness to the exposure time and thus indicate whether a protective coating will form. A linear rate usually indicates a coating which spalls off and gives no protection. An asymptotic pattern indicates that a coating forms which will inhibit corrosion to such a degree that it can progress only a certain amount and no further. Parabolic and logarithmic rates demonstrate "in-between" degrees of corrosion progress and are more frequently encountered than is asymptotic.

Oxygen is generally thought of as the prime high-temperature corrodent. Mr. Moran spoke of some of his experiences with oxidation of nickel at elevated temperatures. He stated that small amounts of different elements have great effects (either good or bad) on the oxidation rate of the parent metal or alloy as they affect the diffusion rate of elements through the oxide scale.

As the amount of the new element is increased, new characteristics of the scale develop. A good example is chromium in nickel. Small amounts of chromium (½ to 1½%) increase the oxidation rate. Above this, the rate progressively decreases. Above 12% chromium maximum protection is attained because sufficient chromium is present to form a scale rich in chromium oxide.

Sulphur attacks in much the same manner as oxygen. Sulphides formed usually have much lower melting points than the parent alloys. The sulphides may melt and flow over uncontaminated areas, corroding them extensively. Again, as in the case of nickel alloys, chromium protects in the same manner.

In some cases, notably with halogen gases, the scale formed may have such a high vapor pressure it evaporates, leaving metal exposed to the attacking gases.

Mr. Moran also spoke of the troubles encountered with vanadium pentoxide, nitriding, carburizing media and residual welding flux. Each offers difficulties which call for new types of protective procedures. Work on all these corrosion problems is constantly bringing new protection methods and better ways to combat high-temperature corrosion.

Mr. Moran supplemented his talk with a series of well presented slides. An animated question period followed Mr. Moran's presentation.

Explains Preparation and Uses of Cemented Carbides

Speaker: L. K. Vry

Archer and Smith, Inc.

L. K. Vry, president of Archer and Smith, Inc., Division of the Wesson Co., presented a talk on "Preparation and Uses of Cemented Carbides" before the **University of Kentucky Student Chapter,** a Louisville Chapter affiliate.

In conjunction with a Wesson Metal film, "This Carbide Age", partially filmed at the University, Mr. Vry stressed the importance of cemented carbides to the metals industry and traced the processing steps in tungsten carbide production.

The importance of a cobalt eutectic in tungsten carbide cutting tools and recent improvements in carbide brazing were illustrated.

The speaker briefly discussed ceramics versus cemented carbides in cutting tools and quality control of WC and WC-Ta processing.

The success of these meetings at the University is assured through an annual grant from the Louisville Chapter, used to promote enthusiasm and professionalism in the student chapter and for publicity of meetings.

Selected to head the Student Chapter for 1959-1960, in an election preceding Mr. Vry's talk, were Charles Dixon, Stanford, N. C., chairman, Lien Wu, Formosa, vice-chairman, Joseph Fister, Lexington, Ky., secretary, William Glover, Louisville, treasurer, and R. C. Duncan, faculty advisor.—**Reported by J. R. Perkins.**

New Films

Research and Development

M. W. Kellogg Co. has released a 17-min. film on research and development of new commercial processes. The film presents a tour of Kellogg's laboratories and pilot plants and shows how an industry can obtain access to a broad process development pattern through cooperative research. Copies available through: Research and Development, M. W. Kellogg Co., 711 Third Ave., New York 17, N. Y.

Assignment Outer Space

A 16-mm., 28-min. film which describes work on re-entry vehicles for the Air Force Atlas and Thor as well as other missile and space projects. It can be obtained by writing to: General Electric Co., Missile and Space Vehicle Dept., Philadelphia 4.

Detroit Educational Series Covers Wear of Metals

Photographed During the Detroit Chapter's Series of Three Educational Lectures on "Wear of Metals" Were, From Left: D. G. McCullough, Technical Chairman, and J. H. Olson, Who Spoke on "Wear of Metals by Scoring"; R. C. Gerhan, Technical Chairman, and T. S. Norman, Who Gave a Talk on "Abrasive Wear of Metals" and A. J. Tache, Technical Chairman, and J. E. LaBelle, Who Spoke on "Wear Resistance of Cast Iron"

A series of three educational lectures on "Wear of Metals" was recently held by the **Detroit Chapter** with lectures on the following subjects:

1. "Wear of Metals by Scoring", by John H. Olson, Engineering Division, Chrysler Corp.
2. "Abrasive Wear of Metals", by Telfer E. Norman, Climax Molybdenum Division, American Metal Climax Co.
3. "Wear Resistance of Cast Iron", by Jack E. LaBelle, Detroit Diesel Engine Division, General Motors Corp.

Mr. Olson described the various types of lubrication used between sliding metal surfaces to maintain a low coefficient of friction. If the load between two sliding surfaces is supported partially by an oil film, a boundary lubrication condition exists. If the oil film is maintained completely between two sliding surfaces, a full fluid lubrication condition occurs and the friction force required is only the force necessary to shear the oil film.

Wear occurs by cutting, abrasion, pitting, corrosion and scoring. The terms scoring, galling and scuffing are often used interchangeably, although scuffing is considered by many as a severe form of scoring. Mr. Olson described a reciprocating-type wear machine, developed in his laboratory, in which a stationary rider sample was held under controlled conditions of loading against a reciprocating wear plate using a 4 in. stroke. SAE 5W oil was used for lubrication and the temperature of the rider sample was measured by a thermocouple during testing. Various types of ferrous and nonferrous materials and coatings were tested using this equipment.

Using SAE 51100 versus SAE 51100 steel, it was found that rough surfaces scored at relatively light loads, whereas smoothy finished surfaces approached full fluid lubrication, operated cooler and supported much heavier loads. It was also found that score resistance increased with hardness. However, cast iron versus cast iron did not show the same relationship as observed with hardened steel and maximum wear resistance was found at an intermediate range of finish.

Rider samples of cast pure aluminum running on steel scored at relatively low loads in comparison to riders of wrought aluminum alloy. Aluminum samples frequently chattered fairly early in the test without gross scoring damage. Pure magnesium, silver and copper riders showed good wear resistance but less than wrought aluminum alloy.

Sintered iron containing some lead showed good score resistance but not as high a load carrying capacity as smoothly finished steel. Composite samples made by tin, silver, or copper plating on knurled hardened steel all scored somewhat above the normal load found with hardened steel without coating. Score loads for proprietary break-in coatings, sulphurized steel and chromized steel were also described. In general, the score resistance was improved by the break-in coatings, by the sulphurized coatings, but no significant increase was achieved by chromizing. Anodized wrought aluminum running on the same material showed very poor score resistance with early damage at light loads. Sprayed molybdenum on steel running on steel showed very excellent score resistance even though a high running temperature was recorded.

Mr. Norman classified abrasion resistant alloys as follows:

1. High chromium irons
2. Medium alloy martensitic white irons
3. Pearlitic white and chilled irons

Class 1 alloys stand at the top of the list insofar as abrasion resistance and toughness are concerned. Included in this class are abrasion-resistant high-carbon toolsteels. In the second class the best known alloys are the "Ni-Hard" irons and a modification of these, known as Climax 321 alloy. Pearlitic and chilled irons are being used in many applications but because of their inferior wear resistance are being replaced more and more by the higher carbon and alloy irons.

The Hadfield-type austenitic manganese steels are used for many abrasion resistant applications. Chromium additions to this steel improve yield strength and resistance to flow, while the addition of molybdenum tends to increase yield strength and reduce carbide embrittlement. Development is in progress, according to the speaker, on lower alloy austenitic-type steels which promise to combine toughness with improved wear resistance.

Mr. Norman described his experience with various types of metals for wear resistant applications in mining operations and discussed briefly the types of wear encountered, which he classified as follows:

1. Gouging or abrasion wear in which particles are in effect cut from the surfaces.
2. High stress or grinding abrasion whereby very small particles are removed by high unit pressures between the abrasive grains and the metal surface.
3. Low stress or erosion wear where very fine particles are removed by low stress scratching type of abrasion.

Mr. LaBelle pointed out that gray iron is a superior wear material where either rapid scoring-type wear or more normal wear occurs. The damage to sliding metal surfaces by the scoring mechanism was described and it was pointed out that with cast iron the graphite smears over the surface, acting as a dry lubricant as well as an anti-welding medium, preventing intimate metal to metal contact.

The Detroit Diesel Cylinder Wear Program, which involves 108 different combinations of material and design and utilized about 550 cylinder sleeves, 360 pistons and over 2,150 piston rings, was described. The scuff test was conducted in a three-cylinder engine normally rated at 90 hp. at 2000 rpm. Increases in horsepower could be obtained by increasing fuel injection or the rpm. The engine was equipped with three test liners, new pistons and rings, and after a standard break-in cycle was run at 90 hp. for 30 min. At the end of this period the engine was removed from test and the cylinders examined for scuffing. The engine was then reassembled and run progressively at increasing horsepowers, disassembling and checking for scuffing after each increase of 5 hp.

Using this technique it was shown that Type A graphite had a definite superiority over Type D and that larger graphite flakes in greater quantities showed superior wear resistance to smaller size and lesser quantities. The effect of matrix structure was also studied and it was found that the poorest structure was the softest but the next poorest was the hardest. The poorest was unheat treated gray iron with Type D graphite and a matrix of pearlite and ferrite, whereas the hardest was the same iron quenched and tempered at 400° F. As the hardened structure was tempered the scuff resistance improved markedly.

The Detroit Diesel work also included a study of the effect of chemical composition on scuff resistance. In general, no effect of chemical composition was noted on scuff resistance except as it affected microstructure.

The initial surface finish has a great deal to do with successful break-in. Surfaces rougher than those ultimately achieved with running assist break-in. At the same time they give improved lubrication and prevent scuffing. This tendency was exhibited in the Detroit Diesel test where Type D graphite iron showed increasing scuff resistance at 90 rms. as compared to 30 rms. After running for a number of hours the 90 rms. surface was reduced to 20 and the scuffing tendency again decreased.

It was recommended that in sliding parts, where wear resistance is important, the iron should be specified by microstructure. A good starting point would be pearlitic matrix with Type A graphite, medium graphite size from 4-6 and a hardness of 200-250 Brinell. The carbon content should be in the 3.00-3.50% range. Heat treatment can be used along with changes in graphite size, type and amount, as well as alterations in surface finish, to accommodate problems which arise, if any.

Notes covering each lecture were presented to all attending and a high level of interest was observed throughout the lecture series. — **Reported by N. M. LaZar and R. B. Boswell for Detroit Chapter.**

Reports on Importance of A.S.M. Sustaining Members

J. S. Kirkaldy, educational chairman, **Ontario Chapter,** spoke on Sustaining Member's Night on the question, "What Are We Sustaining?", with reference both to the corporate and personal "we". It was suggested that an important motivation for effort on behalf of the A.S.M. by member and sustaining member alike is self-interest. This self-interest is not only served by the extensive educational services provided but also by crass returns in prestige, entertainment, sales contacts, etc.

Self-interest is, however, neither the only nor the most important propelling force. Humans are, by their nature, the only rational organizing creatures and are therefore the ultimate vehicle in the fight against the heat death of the universe. The evolution of the universe, of the species and of society is a process of local organization in a sea of dissipation, and man, with his entropy-consuming thought process, is the culmination of it all. Scientists today express this behavior mathematically as the principle of minimum entropy production.

While most of us cannot accept a physical basis for values, these arguments do lead to a value system which most educated people take for granted—the freedom and dignity of the individual, a highly self-interested motivation sublimed to the commonweal, a respect for intellectual achievement and the accumulation of knowledge.

In Dr. Kirkaldy's view, the A.S.M., as an organization of striving humans, can be regarded as a supervehicle in the imminently challenging but ultimately lost struggle against the dissipative forces of the universe, and as such is deserving of continued sustenance from all concerned.—**Reported by E. J. Payne for Ontario.**

Technical Papers Invited for A.S.M. Transactions

The Transactions Committee of the A.S.M. is now receiving technical papers for consideration for publication in the Transactions of the Society and possible presentation before the next national meeting of the Society, in Philadelphia, Oct. 17 to 21, 1960.

Many of the papers approved by the Committee will be scheduled for presentation on the technical program of the 42nd National Metal Congress and Exposition.

Papers may be submitted any time up to Apr. 15, 1960, for consideration for presentation at this convention. The selection of approved papers for the convention technical program will be made in May 1960. Manuscripts may be submitted any time during the year and upon acceptance by the Transactions Committee will be processed immediately for preprinting. All papers accepted will be preprinted and made available to any members of the Society requesting them. However, the printing of an accepted paper does not necessarily infer that it will be presented at the convention.

Reprinting of accepted papers is done quarterly; notification of their availability is published in *Metals Review.*

Manuscripts in triplicate, plus one set of unmounted photographs and original tracings, should be sent to the attention of T. C. DuMond, field secretary and program coordinator, American Society for Metals, Metals Park, Novelty, Ohio.

Should it be your intention to submit a paper, please notify A.S.M. A copy of the booklet entitled "Suggestions to Authors in the Preparation of Technical Papers" will be gladly forwarded. This booklet may help considerably in the preparation of line drawings and illustrations.

Dislocations Covered at Los Angeles

Shown at a Meeting of the Los Angeles Chapter Are, From Left: William V. Ward, Vice-Chairman; William V. Wright, Technical Chairman; William G. Johnston, General Electric Research Laboratory, Who Spoke on "Properties of Individual Dislocations"; and H. A. Curwen, Chapter Chairman

Speaker: W. G. Johnston

General Electric Co.

Direct observation of the "Properties of Individual Dislocations" was the subject discussed at a meeting of the **Los Angeles Chapter** by William G. Johnston, research associate in the Metallurgy and Ceramics Dept., General Electric Research Laboratory.

The discovery of dislocations in crystals and the gradual emergence of the significance of these defects in explaining the basic properties of materials represents one of the most exciting developments in the metal science in recent years. Only in the past ten years have the methods needed for the direct observation and measurement of dislocations been known and used.

Study of dislocations in crystals is done chiefly by four methods—etch pit, decoration, X-ray and electron-microscopic. Each of these methods has certain advantages and disadvantages which enable certain properties to be studied in their best manner or with least difficulty.

In etch pit work, the surface of a single crystal is carefully polished and then etched to disclose the dislocations. By a proper choice of etchants, new and old dislocations may be separately distinguished in some crystals. By chemically polishing the etched surface, new fresh surfaces can be successively etched to perhaps 15 microns below the old surface. Successive etching and polishing can actually provide a three-dimensional perspective of a dislocation. The disadvantages of surface observation are off-set by the short time and simple apparatus needed in etch pit work. Controlled experiments can be run easily on a large crystal.

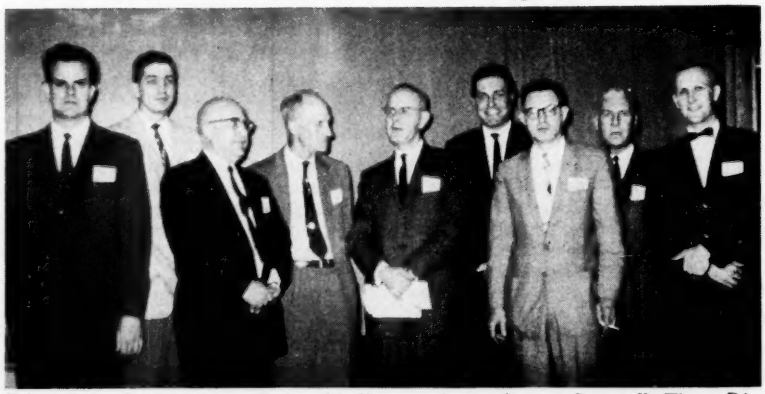
Decoration is the term applied to the observation of dislocations in transparent crystals by precipitation of a dissolved impurity in the crystal. The impurity precipitates along the dislocation lines and outlines them in this manner. All the dislocations in a crystal can be observed optically and by cutting the crystal the dislocation networks may be viewed at different angles. The draw-back is that once a crystal has been decorated, the dislocations have been set and cannot be changed.

X-ray studies of dislocations may be done either through thin sheets with few dislocations or may be used to study dislocations on a crystal surface. The resolution is not as good as the other methods but since simple orientation and crystal set-ups can be used, it is fairly fast.

Dr. Johnston pointed out that dislocations are best studied using an electron-microscope and extremely thin sheets, 500 to 1000 angstroms thick. Actual photographs and motion pictures of the movements of dislocations as stresses are applied have been taken. This method also offers the best resolution down to 10 to 50 angstroms during observation. The basic draw-backs are the high cost of equipment and the fact that thin foils do not act the same as bulk crystals, and the difficulty of doing controlled experiments with such thin specimens.

The studies of Dr. Johnston and his co-workers have been related to dislocations in metals and their cause and effects. Four ways to originate the first dislocation in a crystal are: surface damage; inclusions and precipitates; the dislocation network that formed during solidification; and nucleation of new dislocations by very high stresses on the order of 1,000,000 psi. Their studies have also shown that dislocations often multiply by a process that involves cross-glide between parallel planes, and that dislocation mobility is what determines crystal strength. Dr. Johnston illustrated these observations with slides of dislocations in crystals.—**Reported by J. A. Ferrante, Sr., for Los Angeles.**

Muncie Holds Education Night Meeting



"American Education and the Challenge of the Soviet System" Were Discussed by John R. Ludington, Director, Aid to State and Local Schools Branch, U. S. Dept. of Education, at a Joint Meeting of the Muncie Chapter A.S.M., Delta Chapter, Indiana Society of Professional Engineers, Marion Engineers Club and the Muncie Technical Society. Dr. Ludington pointed out that we are engaged in a race for knowledge and this has led to the cultural exchange agreement set up between the U. S. and the Soviet Union. Shown are, from left: Bill Kahle, president, Delta Chapter, I.S.P.E.; John Baker, president, Muncie Technical Society; Les Neher, coordinator; Ed Zetterberg, president, Muncie School Board; Dr. Ludington; George Knollenberg, president, Marion Engineers Club; Harold Reeves, Muncie Chapter vice-chairman; John Emens, president, Ball State Teachers College; and Robert McCreery, chairman of the Muncie Chapter A.S.M.

Chicago-Western Sees Cold Extrusion Process

The Chicago-Western Chapter's fifth session in its educational series featured a tour of the Verson Allsteel Press Co. to see demonstrations of cold extrusion of steel. A 10-min. film, "Automated Cold Extrusion", preceded the tour.

The cold extrusion part starts as a slug sheared from a coil or bar stock steel. The slug is then deburred, upset or coined, heat treated, lubricated and finally extruded. The upset or coining operation, together with the heat treatment, is necessary to obtain a close die fit in extrusion and to aid in developing a spheroidized structure which is desirable for good plastic flow. Slug lubrication is an important requirement and is performed in nine steps: alkaline cleaner, cold water rinse, acid pickle, cold water rinse, hot water rinse, coating with Bonderite, cold water rinse, neutralizing rinse, and Bonderlube lubricating coating.

The cold extrusion operation may be backward, forward or a combination of the two extrusion processes. Punch speeds range from 7-20 in. per sec. and depend on alloy, reduction in area and shape of slug. Press capacity necessary for plastic flow depends on slug material, size and area of die orifices, size and area of punch and friction area of tooling in contact with the slug. The successful extrusion operation requires the understanding of how the metal flows plastically under pressure, how to design tools for maintaining tolerance and strength and how much the metal can be worked.

Cold extrusion was shown to be very economical for automation and has the advantage of using standard coil stock and chipless forming of metal into a product. Bearing races of 1016 steel were produced with a 400-ton press at the rate of 5600 per hr.; a ¾ in. diameter coil stock was forged into a 1 1/16 in. diameter slug which was extruded into the final product with a 40% saving in material over the machined product. Propeller shaft ends of 1035 steel were extruded at 750 per hr. on a 600-ton press. Other examples included a ball stud from 5120 bar stock, a rotor gear, door-latch component for automobiles from 1010 steel, mechanical tappets, bearing cups and spark plug shells from 1008, 1012 and 1017 steel.—**Reported by John J. Byrnes for Chicago-Western.**

Describes Explosive Metal Forming

Allen T. Fuller, National Northeastern Div., American Potash and Chemical Co., Spoke on "Explosive Metal Forming" at Rochester. Shown are, from left: Russel Brush, vice-chairman; F. Gehrlein, chairman; and Mr. Fuller

Speaker: Allan T. Fuller, Jr.

National Northeastern Div.
American Potash and Chemical Co.

Rochester Chapter members and guests heard a talk on "Explosive Metal Forming" by Allan T. Fuller, Jr., National Northern Division, American Potash & Chemical Corp.

Mr. Fuller gave a brief history of the development of the technique, present status and areas in which it should prove useful in the future.

Mechanical or hydraulic energy used in conventional forming is replaced with locally placed high-energy explosive charges with a detonation energy of 25,000 ft. per sec. which moves material at a measured rate of 300 ft. per sec. This extreme rate of material deformation results in less cold work and less temperature rise than is encountered in the usual drawing operations.

Reproducibility and close tolerances are obtained by controlling the optimum detonation rate, amount, geometry and positioning of the explosive charges.

The process was described as being advantageous in conditions where springback defies regular forming, or where small quantities make the cost of dies prohibitive. Explosive forming uses the female die only; metal is forced into the cavity by placing the charge in water or other media which transmits the energy of the charge. Further advantages are found in cases where extreme energy is required, or where very large parts must be formed.

The final portion of Mr. Fuller's talk was devoted to a colored movie which he narrated.

At the same meeting a $500 scholarship was presented to David Stokes, a senior in mechanical engineering at the University of Rochester.—**Reported by N. Iannone for Rochester Chapter.**

Gets A.S.M. Scholarship at Rochester

Shown Receiving a $500 A.S.M. Scholarship at a Meeting of the Rochester Chapter Is David Stokes, Senior in Mechanical Engineering, University of Rochester. From left are: John W. Graham, dean of the College of Engineering, University of Rochester; Mr. Stokes; Frank Gehrlein, chairman; and Richard F. Eisenberg, professor at the University of Rochester

William M. Baldwin, Jr., Case Institute of Technology, Spoke on "Why Metals Bust" at a Meeting Held in St. Louis. Shown are, from left: Dr. Baldwin; Irving Rozalsky; R. D. Leslie, then chairman; and R. C. Rueff

Outlines Causes Of Metal Failures

Speaker: W. M. Baldwin, Jr.
Case Institute of Technology

A meeting of the St. Louis Chapter featured a talk on "Why Metals Bust" by William M. Baldwin, Jr., Case Institute of Technology. Dr. Baldwin translated many of the phenomena responsible for metal failures into terms that enabled the entire audience to comprehend some of the mystifying 'premature' failures which continually plague all metal users.

Four type of failures concerned mainly with embrittlement or loss of ductility were discussed. Dislocations or discontinuities in the atomic structure of a metal are a "garbage pile" for impurities which, at intermediate temperatures and correlative diffusion rates, do not allow slip planes to flow smoothly. Since ductility is a function of temperature and strain rate, intermittent slippage resulting from impurities or parasitic atoms will cause a loss of ductility at intermediate temperatures, known as blue brittleness. Elimination of these effects is required if the metal is to be deformed. The effects of blue brittleness may be overcome by a change in working temperature or a decrease in speed of deformation. Hydrogen, as an embrittling agent, has an effect only under certain conditions. The effect is most pronounced at low strain rates and therefore will not noticeably affect the ductility during a normal tensile test or comparable rates of deformation. Slowing down rate of deformation or increasing working temperature will increase embrittling effect of hydrogen.

Loss of ductility due to strain rate sensitivity is not only a function of temperature and strain rate but is also a function of the metal. The ductility of low-carbon steel is not appreciably affected by strain rate variations or speed of deformation. Austenitic stainless steels are greatly affected by speed of deformation, ductility decreasing with increasing speeds. For these types of metals, tensile tests at room temperature are not correlative with other conditions of testing or deformation. As an example of strain rate sensitivity, the optimum head-to-shank ratio of cold headed carbon steel bolts (about 1.8) does not vary appreciably with strain rates up to 10^4 in./in/min., but the austenitic stainless steels have a very high ratio at low strain rates and a very low ratio at high strain rates.

Dr. Baldwin pointed out that the embrittling behavior of a surface treated steel, such as a carburized surface or a chromium plated surface, is nothing more than a notch effect. In the tensile test or similar deformation, the applied stress causes the brittle surface to crack, creating a very sharp notch and ultimately causing a brittle failure.

Case hardening of a surface to a depth of 0.008 in. will lower the tensile ductility to one-half the base metal value. In effect, this is merely the increasing of the notch sensitivity of the composite by the treated surface and the behavior of the composite then depends upon the notch sensitivity of the base metal. Notch tensile tests of the base metal will give good correlation with the effects of a brittle coating or surface.

Dr. Baldwin emphasized the fact that metal failure is not a single event or experience but the accumulation of lifelong experiences, comparable to a human's medical history. (Would this be a 'metacal' history?) Considering that metals bust only when stresses get higher is unwise, false and dangerous.—**Reported by W. F. Kaufman for St. Louis.**

Improved Properties of Vacuum Melted Metals Described at Golden Gate

Speaker: F. N. Darmara
Kelsey-Hayes Corp.

Golden Gate members heard F. N. Darmara, president of the Metals Division, Kelsey-Hayes Corp., give an authoritative talk on the "Vacuum Induction Melting of Metals".

Dr. Darmara pointed out several unusual features of the Kelsey-Hayes vacuum melting facility. Of particular interest is the vacuum chamber enclosing the melting crucible. Considerable volume has been saved by designing the chamber to tilt along with the crucible when pouring takes place. Special vacuum-tight trunnion supports allow the unit to maintain pressures down to 3 microns of mercury.

F. N. Darmara

Because of the time required in melting a heat of metal, more refining is allowed than in the case of arc melting or electron beam melting. In many cases, the removal of deleterious constituents from the melt results in improved physical properties. An example of this is the marked improvement shown in the series of hardenable stainless steels which are strengthened by the formation of titanium and aluminum intermetallic compounds with nickel. Since both aluminum and titanium are strong oxide formers, vacuum melting may be used to secure improved and uniform physical properties by reducing the oxygen content in the melt to a minimum. The residual oxygen content is determined by the equilibrium established between the liquid metal and the crucible material. This value is many times that predicted by the thermodynamic approach.

Dr. Darmara pointed out that vacuum melting will allow study of the effects of trace elements on alloy properties, an area very poorly understood at present. He presented data which showed that lowering the boron content below 20 ppm. caused a drastic reduction in the stress-rupture properties of Waspalloy. Such data, Dr. Darmara predicts, will ultimately lead to alloys designed to take advantage of vacuum melting. — **Reported by R. L. Skaggs for Golden Gate Chapter.**

Explains Explosive Metal Forming

Robert A. Cooley, Executive Vice-President, Chromalloy Corp. of New York, and General Manager, Propellex Division, Presented a Talk on "Explosive Metal Forming" at a Chicago-Western Meeting. Shown are, from left: Paul K. Zimmerman, chairman; C. E. Swartz, technical chairman; and Mr. Cooley

Speaker: Robert A. Cooley
Chromalloy Corp.

Robert A. Cooley, executive vice-president, Chromalloy Corp., and general manager of the Propellex Division, spoke on "Explosive Metal Forming, at a meeting of the **Chicago-Western Chapter.**

Although explosive forming of metal is not a panacea for the metal fabricator, interest continues to grow in explosive forming because it has been shown to be suitable for shaping certain forms of high-strength alloys and it permits fabrication of certain sizeable metal parts in limited numbers with a lower capital investment than a process requiring expensive large presses. Explosive forming is not competitive with present stamping or pressing methods for small or medium-size pieces now mass produced.

Dr. Cooley sees the creation of "explosive job shops" which will develop special explosive charges, explosive forming dies and a detailed process for the customer's use at his plant or simply explosive-form metal parts for the customer.

The history of explosive forming was traced from the discovery of the Munroe effect in 1888. Munroe observed that if an explosive charge with letters countersunk into its surface is detonated with its lettered surface in contact with or near a metal plate, a focusing of energy occurs and the letters are indented into the surface of the metal plate. In 1897 an Englishman, W. C. Johnson, obtained a patent on using explosives for expanding a small tube within a larger tube in bicycle manufacturing. In 1901 a patent was issued for a method of shaping metal by hydraulic pressure created by an explosive. Explosive rivets were patented in 1937. In 1950 the Moore Engineering Co. produced hubs for fans several feet in diameter by explosive forming.

The use of an explosive charge provides detonation velocities as high as 9000 m. per sec. with accompanying brief pressure peaks of the order of 2.5 million psi., as compared to the 1 to 5 ft. per sec. rate in drawing and extrusion processes. The explosive charge may be a propellant such as smokeless powder with a linear deflagration rate of a few inches per second, or a high explosive like TNT, PETN or RDX, with detonation rates of 6600 to 8300 m. per sec. The charge can be used in the form of sheet, cones, hemispheres, cord or gun cartridges. The medium between the charge and the metal to be formed may be air, water, rubber or solid spheres. Dies of glass cloth reinforced plastic, metal-lined reinforced concrete, Kirkite and toolsteel have been used.

Slides illustrated examples of explosive forming such as the noise suppressor tubes used on the Boeing 707 jet engine, rocket thrust tubes, beading and blistering on missile shells, turbine blade shaping after a welded fabrication, intricate shapes with refractory metals, and the surface rehardening of Hadfield steel railroad tracks while in service. Many metals have been formed, such as titanium, columbium, molybdenum, tantalum, 302, 304, 310, 316, 321 and 347 stainless, cold rolled 1010 and 1015 steels, carbon steels, 17-7 PH and AM350 steels, aluminum and magnesium alloys.

Questions from the floor outlined some of the more salient features of explosive forming. Contamination of the metal by explosion products may be conceivably limited by using various charge compounds, the important products of explosion being CO, CO_2, N_2 and nitrogen oxides. Exploding a metal against a die results in very small springback, excellent die impression and surface finish. Many important aspects of the process are proprietary secrets of companies working in this field.—**Reported by John J. Byrnes for Chicago-Western.**

Philadelphia Hears Talk On Point Defects in Metal

Speaker: Doris Wilsdorf
University of Pennsylvania

Doris Wilsdorf, associate professor, University of Pennsylvania, discussed "Point Defects and the Plastic Behavior of Metals" at a meeting of the **Philadelphia Chapter.** The speaker is the first woman in 40 years to present a formal talk before the Chapter.

A large audience was on hand to honor past chairmen of the Chapter. Frank G. Tatnall was the coffee speaker.

The overriding importance which the particular type of lattice defects, called dislocations, has for the plastic properties of metals has been fully recognized for the past quarter of a century. Consequently much research has been done to investigate the properties of dislocations, as well as their interaction with each other, with impurities in solution and in the form of precipitates, with grain and subboundaries, with surfaces, internal stresses, conduction electrons and heat motion. Now it appears that thermal vacancies and interstitials are more important for the understanding of the plastic behavior of metals than many of the named entities. More thorough investigation into their properties and their effects on dislocations are being conducted, and some interesting results are now available, bearing on the phenomena of quench hardening, irradiation hardening, work hardening, fatigue, diffusion under stress and age hardening.

Dr. Wilsdorf illustrated her talk with several slides. — **Reported by N. J. Petrella for Philadelphia.**

A.S.M. Members' Names Added To Quarter Century Club Roster

The following A.S.M. members have been awarded honorary certificates commemorating 25 years consecutive membership in the Society:

Akron—George L. Scheck.

Baltimore—Black & Decker Manufacturing Co.

Boston—Harry D. Baker, R. T. Sadler, Jr.

Buffalo—Delmont D. Barbor, W. L. Harbrecht, L. W. Krum, Frederick A. Purdy, Earl H. Seelbach, Arthur H. Suckow.

Calumet—Orville T. Barnett, Arnold S. Grot, Walter J. Schaefer.

Canton-Massillon—F. C. Brandon, Canton Drop Forging & Manufacturing Co., Eaton Manufacturing Co. Reliance Division, Oscar John Horger, David C. Ladd, James F. Reid, Sr., Garland M. Riegel.

Chicago—Roy D. Allen, O. J. Arness, F. C. Behlmer, H. Etherington, P. Fee, A. F. Finkl, General Alloys Co., John J. Golden, Joseph W. Gray, Alois B. Hebeisen, Harry W. Highriter, Henry G. Holtz, Joseph F. Houdek, Kropp Steel Co., John E. Larson, C. Robert Lillie, F. W. Long, C. R. McEwen, J. T. Rudd, Charles W. Saenger, John B. Stevens, Ernest A. Sticha, L. G. Swenson, Universal Cyclops Steel Co., C. Wickemeyer, Wyckoff Steel Co., Louis Ziffrin.

Chicago-Western—J. D. Graham, F. A. Hansen, Carl E. Swartz.

Cincinnati—Hamilton Foundry Inc., Bernard J. Lehman, Ralph J. Stolle.

Cleveland—Ray Abernethy, American Steel & Wire Co., Donald E. Babcock, Cranston H. Carpenter, East Ohio Gas Co., Howard W. Emig, A. P. Ford, Glen J. Guarnieri, John W. Hill, David E. Johnson, M. R. Koehn, F. W. Krakora, R. E. Lamb, V. H. Leichliter, J. O. Light, Jr., C. R. Marsh, A. O. Mason, H. S. Meshorer, H. P. Rassbach, Andrew J. Repko, L. W. Rice, William Rodgers, Joseph T. Ryerson & Son, Inc., Sandvik Steel, Inc., Louis E. Saraz, Jr., Edward A. Schmotzer, Rollin A. Snider, Joe L. Stone, The Timms Spring Co., H. J. Warwick, Weldon Tool Co.

Columbus—Samuel H. Yost.

Dayton—Robert L. Davidson, Dayton Forging & Heat Treating Co., Inland Manufacturing Division General Motors Corp., Colin McInnes, Jr., James W. Poynter, Clarence E. Rigby.

Delaware Valley—F. W. Roebling, III, M. L. Samuels.

Detroit—Delmar Anderson, Robert J. Belz, Lorne W. Brothers, Ivor Bryn, James R. Buchanan, C. Harry Clark, F. B. Cornell, C. Willis Dietz, Calvin A. Hooker, Ernest O. Kirkendall, Frank M. Levy, Leonard C. Masey, Clifford Menzies, William H. Snair, Herbert N. Steinberger, A. R. Stevenson, Edward D. Wiard.

Eastern New York—C. J. Boyle, Clifford W. Gisner, Matthew A. Hunter, Augustus Jones.

Golden Gate—Edward Doleman.

Hartford — Ferdinand Hintz, Pius L. Paskus, Charles E. Spragg.

Indianapolis — Bernard J. Esarey, George F. Haislup, B. R. Haueisen, Prescott B. Jensen, N. B. Jones, E. I. Larsen.

International — H. H. Burton, Dr. Herbert Harris, Robert Hunter.

Jackson—Andrew S. Black, John T. Bryce, Albert E. Rhoads.

Lehigh Valley — E. H. Howells, W. H. Kemper, Andrew Schwartz, Jr., S. W. Traylor, Jr., H. W. Van Dyke.

Long Island—Samuel Frankel.

Los Angeles—J. A. Burgard, Robert J. Exter, Frank X. Moore, William O. Owen, William T. Southward, C. F. Weisgerber.

Louisville—Wilton F. Melhorn.

Mahoning Valley—Karl L. Fetters.

Milwaukee — H. W. Butterbaugh, W. W. Edens, C. A. Furgason, R. N. Schaper, W. B. Sobers, Philip Rosenthal, Metal Treating, Inc.

Minnesota—J. B. Bambenek, W. E. Mowrey Co., Leroy Owen, William M. Pore, Knox A. Powell, J. E. Williams.

Montreal — Canada Foundries & Forgings Ltd., Dominion Steel & Coal Corp., Ltd., La Salle Builders Supply, Ltd., Arch S. Wilson.

Muncie—F. C. Nilson.

New Haven—Carpenter Steel Co., John E. Corcoran, D. K. Crampton, Lawrence W. Hayden, Walter R. Meyer, W. A. Schlegel.

New Jersey — William C. Bellis, Judson L. Cannon, James A. Coe Steel Co., Gerald B. Duff & Co., Peter A. Frasse & Co., Inc., Frank W. Hanson, William Klaile, McWilliams Forge Co., F. W. Mencik, Oscar O. Miller, W. A. Olsen, Fred P. Peters, Joseph T. Ryerson & Son, Inc., R. C. Schatzman, Albert A. Smith, Jr., William Von Seggern, Worthington Corp.

New York—John L. Cahill, Robert R. Clappier, Roy F. Hancock, Emil A. Imbembo, William Spraragen, Kelvin Sprcule.

North Texas—Edwin Joyce, Arnold O. Moelk.

Notre Dame—Frederic H. Craven, A. B. Matern.

Oak Ridge—Richard M. Lord.

Ontario — William D. Lamont, Linde Co. Division of Union Carbide Canada Ltd., Harry Thomasson, H. C. Upton, P. G. Welford, York Gears Ltd.

Peoria — Caterpillar Tractor Co., D. P. Sommer, Herman Stettner, Frank W. Werkle.

Philadelphia — William M. Adler, William J. De Mauriac, Horace Drever, Henry S. Freynik, H. A. Heiligman, George J. Kaiser, H. L. McClees, Albert L. Neudoerffer, Charles F. Pogacar, Edgar K. Spring, Charles A. Turner, Jr., Harley S. VanVleet, I. W. Wilenchik.

Pittsburgh — William C. Aber, James B. Austin, Allan W. Beatty, Lawrence R. Brown, Arthur C. Cusick, William A. Dennis, Edgewater Steel Co., Walter B. Farnsworth, Hyman Freeman, William C. George, Benjamin Lustman, B. R. Mueller, John F. Robb, Joseph Robbins, J. Paul Sherwin, R. W. Snyder, Robert Lorth Stephenson, William H. Thomas, M. J. Weldon, P. R. Wray.

Puget Sound—Frank W. Dearborn, Thomas O'Brube.

Rhode Island—Arthur S. Johnson.

Rochester — Gordon B. Cowles, Charles E. Vaughn.

Rockford—Fred Hockman.

Rocky Mountain — Frederick A. Pease.

Sacramento Valley—Harold C. Olson.

St. Louis—Robert C. Rueff.

Syracuse—Ralph O. Brown, Louis J. Madden, William Young.

Springfield—Rathbone Corp.

Texas — C. A. Fischer, Earle M. Jorgensen Co.

Toledo—A. L. Kershaw.

Tri-City — Walter Gustafson, J. Schmelzer.

Washington — Allegheny Ludlum Steel Corp., Richard E. Wiley.

West Michigan—George K. Minert.

Wichita—G. A. Sellers.

Worcester—Arthur J. La Croix.

York—H. I. Hartman.

Testing and Inspecting of Steel Forgings York Topic

Speaker: A. O. Schaefer

Pencoyd Steel and Forge Corp.

A. O. Schaefer, president, Pencoyd Steel and Forge Corp., and past president A.S.M., presented a talk on "Testing and Inspecting Steel Forgings" at **York Chapter.**

Volumes have been written about the testing of steel products. The variations in testing techniques, and the numerous theories and practices that have been built up around them, testify to the importance of the subject to the design engineer. The testing of steel forgings shares in this interest and in the work that has been done on it.

This talk showed modern applications and thinking as applied to old techniques, as well as the modern methods that are finding a place in our inspection world. Mr. Schaefer pointed out that the science of testing as applied to steel forgings is well developed and more than adequate to meet today's needs. There are, however, needs for more knowledge, particularly in interpretation of results.

Special consideration was given to ultrasonic testing, and means of testing to avoid brittle failures in service.—**Reported by J. A. Oless for York Chapter.**

M.E.I. Names Student of the Year

The instructional staff of A.S.M.'s Metals Engineering Institute has just selected Donald K. Hayes of the Link Belt Co., Indianapolis, as "M.E.I. Student of the Year".

This naming of the outstanding home-study student will be an annual event and the person so honored will be awarded his choice of any of M.E.I.'s 20 courses.

Donald K. Hayes

Donald Hayes, first recipient of this distinction, is 31 years old and works as a laboratory technician on metallurgical problems connected with production at Link Belt. He is married and has two children and is a high-school graduate. He completed the M.E.I. course on "Heat Treatment of Steel" in a period of eight months with the unusually high average grade of 97.

He has indicated that he will select either "Mechanical Testing and Inspection" or "Corrosion" as his next course. Both are currently in preparation and will become available in a short time.

Mr. Hayes commented of his first course: "I found it both interesting and enlightening . . . I have already recommended it to my friends".

Discusses Metallic Wear

Speaker: W. E. Jominy

Chrysler Corp.

Notre Dame Chapter opened another season of activity with an interesting address on "Metallic Wear" by Walter E. Jominy, national secretary A.S.M. Mr. Jominy is presently associated with the Chrysler Corp., Detroit, as a consultant. He discussed the considerations involved in choosing a proper combination of metals in order to increase wear resistance. His talk was well illustrated by slides showing case histories of wear problems, and was followed by a lively question and answer session.—**Reported by R. C. Pocock for Notre Dame.**

METALS ENGINEERING INSTITUTE **NEWS**

Cleveland Sponsors Course

The second M.E.I. course to be sponsored in the Cleveland area under chapter sponsorship was even more popular than the first course offered last year. Forty-five students are enrolled and, according to Lewis Berger, chairman of the Educational Committee, there is no evidence of a single drop-out. He expects that all 45 will complete the course satisfactorily in February.

Chapter-sponsored courses are also under way in Warren, Fort Wayne, Rochester, Worcester, Houston, two in San Francisco, four in Los Angeles, four in Columbus, two in Newark, two in Utah, one in Syracuse. Others are being planned for Chicago, Muncie, and several additional chapters. At the present time, about 650 persons are studying M.E.I. courses under chapter sponsorship.

Any chapter wishing to receive information on the presentation of chapter-sponsored M.E.I. courses is urged to write to the M.E.I. office at the A.S.M. Headquarters, Metals Park, Novelty, Ohio.

Courses under way include: Elements of Metallurgy, Heat Treatment of Steel, Stainless Steels, Electroplating, High-Temperature Metals.

First Graduate of M.E.I.'s Copper, Brass & Bronze Course

W. J. Russell, of Bridgeport Rolling Mills Co., has the distinction of being the first person to complete M.E.I. Course 25, "Copper, Brass and Bronze". This course, prepared by Owen Ellis, currently consultant, and formerly director of the department of engineering and metallurgy, Ontario Research Foundation, is highly regarded by men in the industrial field. Numerous enrollees are studying the new course and an in-plant training program is under way at Chase Brass and Copper Co., using Dr. Ellis' M.E.I. course as the text. The course covers all aspects of copper metallurgy from extraction, smelting and refining to casting, hot and cold working and machining.

Mr. Russell's formal education has been limited to high school, plus a few noncredit courses in metallurgy and mathematics in his spare time. He presently serves Bridgeport Rolling Mills, producers of brass, bronze and aluminum strip, as manufacturing superintendent. He has been with the company 25 years.

Mr. Russell says of the M.E.I. course "It was very informative and covered phases of processing which were of vital interest to me. The text was clear and test questions of such a nature as to require a thorough coverage of lesson material".

METALS ENGINEERING INSTITUTE IS ON THE MOVE

Plans for the Cleveland Chapter's M.E.I. Course Were Made at a Dinner Meeting of the Educational Committee With National President Walter Crafts. Shown are, from left: Emil Perout, head of the Metallurgy Dept., Fenn College, and chairman of the Student Affairs Committee; Art Schwope, Clevite Research Center; Fred Siegrist, M.E.I., and a class instructor; Tone Brasunas, M.E.I. director; Mr. Crafts; and Lewis Berger, M.E.I., and chairman of the Chapter's Educational Committee

Presents Views on Powder Metallurgy—Today and Tomorrow at Rhode Island

Speaker: John D. Shaw

S-K-C Research Associates

John Shaw, president, S-K-C Research Associates, presented a talk on "Powder Metallurgy; Today and Tomorrow" at a meeting of the **Rhode Island Chapter.** Mr. Shaw has worked in the many facets of the field of powder metallurgy and has published numerous articles on the subject.

Examples of today's uses of powder metallurgy for mechanical parts are familiar and unlimited. It is interesting to note that in its commonplace use for automatic washing machines parts manufacturers are offering longer and longer service warranties. Indeed, manufacturers are planning for the day when lifetime guarantees will be offered, which is indicative of the quality that parts made by powder metallurgy are expected to have in the coming years.

For an understanding of the import of powder metallurgy today and tomorrow, consumption figures are of interest. The present yearly consumption of iron powder is 40,000 to 50,000 tons per year, while that of copper powder is 20 to 25 tons. These tonnage figures are a measure of uses and savings that may accrue to the manufacturer of powdered parts. Savings result despite high initial powder cost from such factors as savings in scrap, lighter weight, elimination of intricate machining, more rapid and automatic production, and less costly labor.

A current process about to reach fruition is the rolling of metal powders. This is an example of the efforts which are about to break through current barriers and develop powder metallurgy into a mature full-fledged member of the competitive metalworking field. Consolidation of metal powders by rolling offers not only a means of making combinations of metals and nonmetals, of two metals mutually immiscible, or of metal powders of extremely high melting points, but also provides a way for cheaper fabrication of conventional alloys. The real commercial potential lies in the latter. This rolling in its commercial consideration will be a full-scale, continuous operation of producing practically infinite lengths. While the current methods were first mentioned in published form only about six or seven years ago in Germany, the process is well advanced in this country.

Briefly, the rolling process starts with the feeding of powders from a hopper into a set of rolls, the rate of feeding depending on the type of powder. As the powder flows into the rolls it is compressed and the porosity decreases to some optimum compared to the power consumption of the rolls. Various in line combinations of sintering, hot or cold rolling and heat treatment are employed depending on the material and product. Full densities and properties equivalent to conventional rolled strip can be obtained. The continuous flow and less steps and handling account for attractive saving.

Mr. Shaw mentioned many other applications of powder metals and the unique combinations, such as the cermets. A picture was shown of a "flash sintering" machine which can simultaneously supply pressure and current to produce substantially instantaneous sintering and structures unlike those found in conventional processing. In one case during an experiment titanium carbide was liquefied and sprayed from the die. **—Reported by Edward D. Hyman for Rhode Island.**

Wins Show Book Award

Frank B. Rogers, Granite City Steel Co., Granite City, Ill., must own a particularly dependable crystal ball—his guess that 567 A.S.M. technical books would be sold at the recent Chicago Metal Show was just one short of the actual total, 568 (a Metal Show book sales record, by the way).

Mr. Rogers's winning guess sent him free of charge the copy of "Magnetic Properties of Metals and Alloys" (a new A.S.M. title, listing at $8.00) that he ordered at the Show. Congratulations!

Brooklyn Student Receives New York Chapter Award

James Garahan, a student at Brooklyn Technical High School, will receive this year's Student Award from the New York Chapter.

The award will be given for "outstanding achievement in industrial processes". Consisting of an inscribed copy of the Hoover translation of "De Re Metallica", the award will be presented at a general school assembly by J. E. Krauss, professor at New York City Community College and Chapter treasurer.

The name of this year's winner was announced by Max Kohn, chairman of the school's industrial processes department.

Although the Student Award has been limited to Brooklyn Tech in the past, it is possible that the program will be expanded to include two other technical high schools in New York City. Such a recommendation will soon be made to the Executive Committee, according to Columbia's George Kehl, chairman of the chapter's Student Activities Committee which supervises the award.

Gives Talk on Carburizing

Walter H. Holcroft, President, Holcroft & Co., Presented a Talk on "High-Speed, High-Temperature Carburizing" at a Meeting in New Haven. Shown are, from left: Lloyd Raymond, technical chairman; Mr. Holcroft; and Frederick Storm, chairman of the Chapter

Cast Iron Metallurgy Subject

At Worcester's 25-Year Members Night Are, From Left: Donald J. Coleman, Technical Chairman; William H. Moore, General Manager, Meehanite Metal Corp., Who Spoke on "Service Application and Metallurgy of Cast Iron"; and Leonard L. Krasnow, Chapter Chairman

Metallurgical Education In Russia Defined at Ontario Chapter Meeting

Speaker: J. D. Hanawalt

Dow Metal Products Co.

Ontario Chapter members heard J. D. Hanawalt, vice-president, Dow Metal Products Co., speak on "Russian Metallurgical Education" at a recent meeting. In 1957 Dr. Hanawalt spent three weeks in the Soviet Union as a member of the Moscow Steel Institute—New York University Metallurgical Exchange Delegation.

J. D. Hanawalt

The technical institutions in Russia are responsible for industrial development in certain industrial fields, and the industrial plant in turn depends upon the institute for scientific guidance. Personal contact between individuals of both organizations is a vital factor in this process. The scope of this plan is very broad and covers, in some cases, the entire industrial economy from the development of raw materials and natural resources to the manufacture and improvement of finished products. It includes the selection of processes, design of equipment, pilot plants, plant locations, production capacities, costs, labor schedules and safety. The data from which conclusions may be based emanate from nation-wide surveys of the location and quality of available ores, power demand, labor and market distribution.

This teamwork between the plant and the institute remains at a high level during the entire operational life of the plant.

In almost every case, Dr. Hanawalt found his personal contacts to be most interesting and enjoyable. The professors, in particular, he found extremely hospitable and cooperative. Most of them have had plant experience, and many have written comprehensive textbooks. For example, K. L. Strelets of VAMI is the senior author of a 500-page book on magnesium production which serves as a text for the engineering institutes throughout Russia which offer light metal courses. All texts encountered by the speaker were comprehensive, authoritative and up-to-date.

Courses of study are established by a committee of key professors from various institutes who decide on texts to be used as well as the scope of reference reading and extent of the lab work to be done. This is printed and issued to the institutes by the Ministry of Higher Education, thus obtaining a uniform standard for all institutes.

At the age of seven, Soviet children commence their ten-year secondary schooling, and must pass examinations of every description along the way in order to remain. After seven years, those who are not fit leave the academic course and begin four years at trade school. University admission is by examination only. About 60% of the graduates take the exam, about ¼ of these are admitted. In roughly 35 universities and 700 institutes in Russia, there are approximately 2,000,000 students. There are about the same number in trade schools.

Successful students receive a government stipend which is based on both grade and rating. Most start at between 300 and 400 rubles per month and receive various increases according to their standing. Graduates taking a job receive about 1000 rubles per month, and those remaining for post-graduate work receive slightly less. Often the best students become faculty members, which is the highest paid profession in Russia. He stated that according to M.I.T.'s Morris Cohen, Russia is graduating about twice the number of equivalent Ph.D graduates as the U. S.

A professor's basic wage is 6000 rubles per month, in addition to which he receives extra pay for outside work such as lectures or consulting services. If he writes a text, he gets 2000 rubles for every 23 pages. If he is elected a member of the National Academy of Sciences, he receives another 2500 rubles per month for life. If he moves into the highest category, that of academician, the amount is 5000 rubles.

Schools are overcrowded, some working on double shifts. The students are eager and enthusiastic. The libraries are full of foreign publications. Lenin Polytechnic Institute regularly subscribes to 1000 technical periodicals, of which 600 are foreign, including about 100 from the U.S.

Russians are probably writing almost as much as they are reading. Dr. Hanawalt discovered at Kiev University a 400-page text listing 412 references on ductile iron, which, as far as is known, has no English equivalent.

The Russian slogan "To overtake and surpass America" has been part of the Soviet aim since 1920, and it may well be that we can profit greatly by recognizing Russia as a competitor from whom we can learn some useful things, cultural as well as scientific. — **Reported by E. J. Payne for Ontario.**

Talks on Color Harmony in the Home

T. W. Peck, Caterpillar Tractor Co., Miss Ming Hoekstra, Who Presented a Talk Entitled "Color Harmony in the Home" and W. H. Lenz, Caterpillar Tractor Co., Are Shown During a Recent Meeting Held by the Peoria Chapter

Speaker: Ming Hoekstra

Illinois Bell Telephone Co.

Ming Hoekstra, Illinois Bell Telephone Co., gave a talk on "Color Harmony in the Home" at a meeting of **Peoria Chapter.**

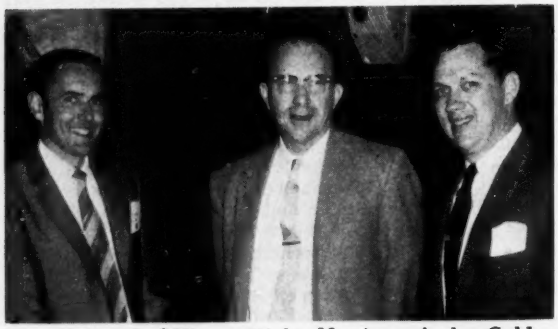
Miss Hoekstra discussed the effect that color has on our emotions and feelings, whether it is in our home or in the conference room. She stressed the importance of surrounding ourselves with colors which are pleasing to us.

Miss Hoekstra noted that the type of people who enjoy using warm colors (red, orange and yellow) are those who "like to talk a lot, like to work with people, and would probably be good salesmen", while, on the other hand, those who enjoy cool colors (green, blue and violet) are "intelligent, dependable and pay attention to details".

Miss Hoekstra explained that a large room appears smaller when decorated in warm colors, while a small room is given a feeling of spaciousness when cool colors predominate. Attractive room color schemes were demonstrated with the use of charts and fabrics.

The program of color was completed with a movie entitled "A Plan for Pleasant Living". The points that Miss Hoekstra had discussed were further illustrated in this movie.—**Reported by T. M. Walton for Peoria.**

Discusses Flow and Fracture



The National Officers Night Meeting of the Golden Gate Chapter Featured a Talk on "Flow and Fracture of Materials" by Earl R. Parker, National Trustee. Shown are, from left: Bob Huggins, program chairman; Dr. Parker; and Bob Ray, immediate past chairman

Describes Aging Treatments

Merrill A. Scheil (Left), A. O. Smith Corp., and National Trustee A.S.M., Who Spoke on "The Effect of Aging Treatments on the Corrosion Resistance of Austenitic Stainless Steels" at a Meeting in Oak Ridge, Is Shown With Technical Chairman W. O. Harms

Describes Industrial Uses of Nuclear Energy

Speaker: R. O. Bardwell

Denver & Rio Grande Western Railroad

R. O. Bardwell, nuclear engineer, Denver and Rio Grande Western Railroad, spoke at **Rocky Mountain Chapter** an "Industrial Applications of Nuclear Energy".

By way of introduction Mr. Bardwell presented a brief film of the research work now in progress at the D. & R. G. W. Railroad laboratories. Of particular interest was the work being done on the irradiation of coal as an additive to fuel oils for use in diesel locomotives. The coal is being added as an energy source to reduce fuel cost.

Mr. Bardwell then discussed basic theories of atomic nuclei and radiation, including means by which materials can be made radioactive and the various wave or particle types given off by radioactive materials. An interesting point brought out was that almost any material can be made radioactive by processes in use today. This gives rise to the many different types of radioisotopes available and allows a wide field of application in industry.

The first use of radioisotopes in industry, and still the main use, is the utilization of the radioactive material as a source of gamma-rays. This application is primarily used in the detection of internal flaws as in radiography. Gamma sources are also used in continuous rolling processes such as steel and paper mills to determine and control sheet thicknesses. Another application of isotopes is their use as tracers. D. & R. G. W. is using this application to study causes of axle failures.

Direct utilization of power from isotopes as heat is being considered in the design of small portable power plants. Radioactive krypton gas is being developed as a light source for use in railroad switching yard lamps, replacing the troublesome kerosene lamps in use. Work is also progressing on design of a nuclear powered locomotive. A considerable amount of effort is being directed toward developing techniques of irradiating food to preserve it with a reduced amount or no refrigeration before consumption.

One of the most interesting applications of isotopes is their use in determining wear rates. At present full-scale studies are being conducted using irradiated piston rings in a captive 1700 hp. diesel locomative. This manner of testing will evaluate any single variable and will detect wear of the rings of one tenth of one billionth of an inch with good accuracy.— **Reported by L. G. Loeske for Rocky Mountain.**

Tells How to Predict Behavior of Metals Under Stress at Puget Sound

Speaker: Mose A. Disotell

Boeing Airplane Co.

The **Puget Sound Chapter** heard Mose Disotell, group engineer—metals and standards, Transport Division, Boeing Airplane Co., speak on a recent advancement in the understanding of "Metal Behavior Under Stress and Subsequent Prediction of Structural Behavior".

It has been known for some time that stresses based on gross areas are neither accurate nor reliable and that actual incremental stresses are impractical to calculate. It thus became apparent that a new approach was needed to insure the maximum in aircraft safety.

Boeing 707 jets fly at higher altitudes and at greater speed than any other commercial aircraft developed. Passenger comfort at these altitudes requires significant internal fuselage pressure. It is evident that under these conditions a defect which could cause a catastrophic or propagating structural failure would probably result in the loss of the aircraft. Structures must, therefore, be capable of sustaining maximum damage without complete failure. From these considerations there evolved the present philosophy of "fail-safe design".

The ability of metals to deform under local stress concentration therefore becomes paramount in material selection. Since most damage or defects in structural members terminate in sharp cracks, an understanding of the behavior of cracks in metals under stress is essential. Mr. Disotell demonstrated that the energy-absorbing ability of a metal containing a crack was a valid measure of the metal's susceptibility to crack propagation. An analysis of the region plastically deformed at the root of a crack is not attempted; instead, the energy absorbed in plastic deformation at the crack root is postulated to equal the energy supplied in causing the crack to propagate. This energy can be measured by means of a suitable specimen which contains a crack. This energy value then is a relative measure of the ability of a material containing a severe notch to withstand stress without ultimate failure.

Mr. Disotell proceeded to demonstrate this test-technique by loading and breaking several aluminum foil specimens containing razor cut slits or notches. He was able to successfully predict the failing or critical stress required to propagate a crack of known length, and to predict the crack length necessary to promote failure under a given stress.

Immediately following this "laboratory demonstration", a movie entitled "Operation Guillotine" was shown. The movie showed full-scale tests of a 707 fuselage being pierced by large spear-shaped indentors. Calculations indicated that the 707 fuselage could withstand a 40-in. crack without ultimate failure. Actual tests verified this calculation.—**Reported by Ted Bergstrom for Puget Sound Chapter.**

Metallurgical News and Developments

A Department of *Metals Review*, published by the American Society for Metals Metals Park Novelty, Ohio

Devoted to News in the Metals Field of Special Interest to Students and Others

Changes Name—Effective with the term beginning Feb. 3, 1960, the name of the Atomic Energy Commission's International School of Nuclear Science and Engineering at Argonne National Laboratory will be changed to the International Institute of Nuclear Science and Engineering. At the same time, the program offered will be expanded and adjusted to take into account the increased need for advanced training in nuclear science and engineering, as well as the increased opportunities to obtain more basic training in these fields at universities.

Announce Ceramic — A polycrystalline ceramic that readily transmits light has been made from powders, according to an announcement by General Electric Co. This material, Lucalox, also possesses the extremely high-strength characteristic of alumina ceramics, can withstand much higher temperatures than most ceramics now in use and can be pressed into any shape desired.

To Translate Journal — The British Welding Research Assoc. is undertaking a cover-to-cover translation of the Russian journal, *Welding Production,* which stresses welding equipment and practice. Subscriptions are available from B.W.R.A., Abington Hall, near Cambridge, England, and cost $11.

Honeycomb Process—The Chem-Mill Division of Turco Products, Inc. and the Norair Division of Northrop Corp. have announced the development of a method for the chemical milling of honeycomb which is expected to broaden the use of honeycomb in airframe construction by permitting the designer greater latitude in utilization of sandwich construction.

Training Course—An intensive training course in nondestructive testing is conducted regularly by Magnaflux Corp. at their Chicago plant. Since Jan. 1, 1959, 13 five-day 40-hr. sessions have covered the basics, the theory and the practice of this testing. Each week-long class is limited to eight men and time is divided equally among laboratory inspection, class discussion and lectures with visual aids. So far, 364 men have completed the course. Further information from: Magnaflux Corp., 7300 W. Lawrence Ave., Chicago 31, Ill.

High-Frequency Furnace — A high-frequency induction furnace, capable of operation in an atmosphere of pure hydrogen or oxygen up to a temperature of 5000° F., has been placed in operation by Radio Frequency Co., Inc., Medfield, Mass. The furnace makes use of zirconia and/or thoria, pure oxide refractories, as a susceptor or heating element. The zirconia is heated by electrical energy from a 30-kw., 10 m.c. induction heater. As the temperature increases the zirconia becomes increasingly conductive, finally reaching a temperature of 4919° F. The equipment can be operated in the open air, or under high atmospheric pressures, using oxygen, hydrogen, inert gases and other common atmospheres.

Cash Awards—The author of the best paper on how electroplating has solved a design, engineering or manufacturing problem or improved a product will receive a $500 award in an article competition recently announced by *Products Finishing,* trade magazine for the metal products finishing industry. Papers should demonstrate the possibilities and practical advantages of electroplating processes. The winning paper will be presented at the Annual Tri-State Regional Meeting of the American Electroplaters' Society, Cincinnati, Ohio, on Apr. 23, 1960. A second award of $250 and five awards of $50 will be made for runner-up papers. Competition ends Feb. 1, 1960. Further details from: Products Finishing Electroplating Industry Award Competition, Gardner Publications, Inc., 431 Main St., Cincinnati 2, Ohio.

Patent Aid—Inventors can obtain a pamphlet published by the U. S. Patent Office, which contains basic information as to patenting and patent procedures and related information which may prove helpful in the development and marketing of their inventions, from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., and Dept. of Commerce Field Service Offices in cities where such offices exist, at 15c a copy.

Engineering Headquarters — Ground was broken on Oct. 1, 1959, for the United Engineering Center, 18-story structure to be erected opposite the United Nations in New York City, which will house the headquarters of 18 engineering societies with a combined membership of more than 300,000.

Die Casting Competition—The New Jersey Zinc Co., producer of Zamak alloy for die casting, has announced a cash awards competition for the best examples of light-weight, thin-wall zinc die castings used in product design. The awards will be made to the designer of the casting in the company which uses the die casting in its product. Entries will be judged on over-all efficient utilization of the advantages of the die casting process combined with the unique casting and mechanical properties of Zamak zinc alloys where the product or components might otherwise have been made as stampings or castings of other materials. First award will be $200, second $100 and third $50. Entry blanks from: Lighter Than You Think Contest Editor, New Jersey Zinc Co., 160 Front St., New York 38, N. Y. Contest closes Jan. 31, 1960.

Latex Developed—Development of a new latex, Dylex KCD-141, with low forming advantages for use in metal primers has been announced by the Plastics Division of the Koppers Co., Inc.

Testing Furnace — An electric hot load testing furnace, capable of pressure sintering at elevated temperatures to 2750° F. at pressures on the heated load up to maximum of 200 psi., has been announced the Pereny Equipment Co., Columbus, Ohio.

President Crafts Speaks at Milwaukee

"Facing the Productivity Challenge: Men and Metals of the Next Decade" Was the Title of a Talk Given by National President Walter Crafts, Union Carbide Metals Co., at a Meeting of the Milwaukee Chapter. Shown are, from left: P. C. Rosenthal, chairman; A. R. Putnam, managing director A.S.M.; Mr. Crafts; and N. P. Milano, technical chairman of the meeting

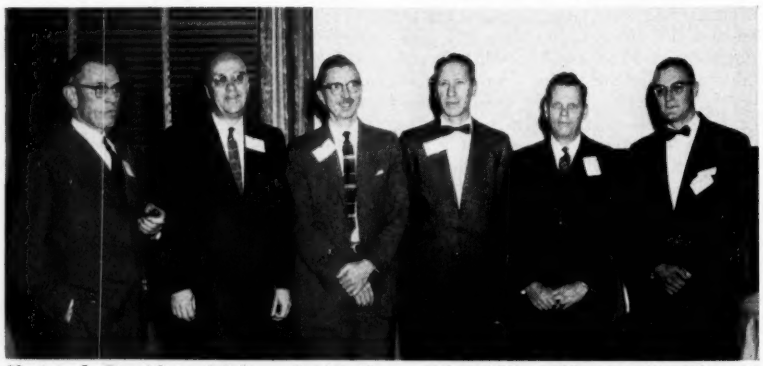
Speaker: Walter Crafts
Union Carbide Metals Co.

The **Milwaukee Chapter** honored its Silver Jubilarians and A.S.M. National President, Walter Crafts, presented 25-year membership certificates to H. W. Butterbaugh, W. S. Edens, C. A. Furgason, P. C. Rosenthal, R. N. Schaper, W. B. Sobers, and Metal Treating, Inc., during a recent meeting.

Mr. Crafts, associate director-technology, Union Carbide Metals Co., presented a talk entitled, "Facing the Productivity Challenge: Men and Metals of the Next Decade". The metalworking industry is meeting the challenge for new materials, properties and techniques. Prior to the space age, the metalworking industry supplied only metal, now they must supply properties. Many of the new developments along this line of supplying metal properties were cited. For example, one such development is an ultra-high-strength steel with a tensile strength of 400,000 to 500,000 psi. Advances in powder metallurgy will have an important impact on the properties of future materials. Powder metallurgical techniques can provide new uses for metals, such as beryllium, and significant developments have been made in the melting and fabricating of other refractory metals, such as columbium.

Mr. Crafts pointed out that developments in blast furnace technology and steelmaking practice are improving present steels. Man's demands of metals are so great that he is developing techniques to upgrade with poor quality ores and is looking to the sea as a source of future metals. The metal fabricating industry is bringing forth new techniques, using such methods as the arc plasma torch, electron beam welder, explosive forming and others.

Along with this terrific pace in industry, Mr. Crafts pointed out that the A.S.M. is acting as a potent catalyst as a source of metalworking information. This is in specific reference to the A.S.M.'s electronic computer indexing system for technical literature searching and speedy dissemination of this information to its members.—**Reported by John F. Hinrichs for Milwaukee.**



National President Walter Crafts Presented 25-Year Membership Certificates at a Meeting of the Milwaukee Chapter to the Following Members; From Left: H. W. Butterbaugh, American Brass Co.; W. W. Edens, Allis Chalmers Manufacturing Co.; P. C. Rosenthal, University of Wisconsin; R. N. Schaper, Appleton Electric Co.; W. B. Sobers, Chain Belt Co.; and T. D. Graham, Metal Treating Co. Clyde Furgason, Ladish Co., and past chairman, was unable to be present to accept his 25-year certificate

Buffalo Members Tour Niagara Power Project

The **Buffalo Chapter** held a recent meeting at the Niagara Power Project, located between the Town of Lewiston and the City of Niagara Falls. About 180 A.S.M. members, wives and children made the 2 hr.-tour of the project.

The Niagara Project, controlled by the Power Authority of New York State, is the construction of a hydro-electric generating plant on the Niagara River, below the Falls. Water for generating is to be obtained from the Niagara River, above the Falls; the amount of water diverted for power use is regulated by the Treaty of 1950 between Canada and the United States. During the daytime, in the tourist season, 100,000 cfs. must flow over the Falls; at night and tourist off-season daytime, only 50,000 cfs. must flow over the Falls. The extra water for power is divided equally between Canada and the United States. Water is diverted from the Niagara River through five miles of underground conduits to the main generating plant and the Tuscarora Reservoir. At night, when power demand is reduced during off-peak hours, some of the power of the main power plant is used to pump the excess water to the reservoir. During the day, with decreased river water flow, water falling 85 ft. from the reservoir generates power in the Tuscarora pump generating plant, and again generates power in the Niagara generating plant by falling another 305 ft.

The Tuscarora pump generating plant will be 993 ft. long and 160 ft. high; it will require 600,000 cu. yd. of concrete, 27,000 tons of steel, and 2,550,000 yd. of excavation. It will have 12 units generating 20,000 k.w. each. The Niagara generating plant will be 1840 ft. long and 389 ft. high; it will require 1,100,000 cu. yd. of concrete, 42,000 tons of steel and 9,750,000 cu. yd. of excavation. Thirteen units generating 150,000 k.w. each will be installed.

Construction work is around the clock; estimated cost is $720,000,000, and the first power produced will be in February 1961. Construction on any part of the project can be seen at anytime of the day on a closed television circuit at the Power Exhibit Building.—**Reported by M. M. Hughes for Buffalo.**

Describes Ferrous Powder Metallurgy and Sintering

Speaker: Robert C. Burgess

Burgess-Morton Manufacturing Co.

Robert C. Burgess, assistant vice-president of manufacturing, Burgess-Norton Manufacturing Co., discussed "Fundamentals of Ferrous Powder Metallurgy and Sintering" at the third lecture of Chicago-Western's educational series.

He stated that the main reasons for fabricating products from metal powders were controllable porosity and self-lubricating properties of the product, fabrication of high melting (refractory) metals, close tolerances obtainable without secondary machining and obtaining of a structural part with a wide range of properties. Powder fabrication makes it possible to produce an infinite number of strength levels with the added advantage of controlling the metal density.

There are three main processes for producing finished metal parts. The first process consists of mixing, pressing and then sintering, and gives tensile strengths from 1000 to 90,000 psi. with 0-15% elongation. Another process has a mix, press, presinter, repress and final sinter procedure which allows tensile strengths of 30,000-170,000 psi. with 0-30% elongation. The last process has a mix, press, sinter and infiltration operation with a resulting 70,000-140,000 psi. tensile strength and 0-5% elongation.

Density is the most important variable and has the greatest effect on the strength of sintered ferrous products. The usual range of density is 5.5 to 6.5 g. per cc. which requires a compression of the powder of 15-35 tons per sq. in. A 0.7% carbon, 5% copper powder with a density of 6.2 to 6.6 g. per cc. will have a tensile strength equal to the yield strength of a low carbon steel; it must be remembered that the yield strength in sintered powders is very nearly equal the tensile strength and is, therefore, compared with the yield strength of steels which is the practical useful limit in machine design.

Two other important variables in sintered powder products are sintering temperature and time. Within the range of practical operation a low carbon steel powder will not be appreciably affected by these two variables while a high carbon (0.7% C) powder is greatly influenced. Heat treatment after sintering normally does not greatly improve strength, but does improve the wear properties of the part.

Finally, the porosity of powder parts can be a greatly desired feature but has been overlooked and considered a necessary evil in liquid metallurgy. Because of its porosity, a powder metallurgy part can be impregnated with lubricating oil to reduce wear, viscous material to increase damping qualities, and nonferrous metals to make possible many new combinations.

Powdered metal fabrication has proved its usefulness and is economically competitive with other fabricating methods. This is illustrated by the many varieties of parts that have been made, such as large spur gears weighing a couple of pounds, pivot-balls used on automobile suspensions, piston rings, parts on roller chains which reduce wear and for many fine parts used in clock mechanisms. It is estimated that daily production of sintered parts averages over five million pieces.—**Reported by John J. Byrnes for Chicago-Western Chapter.**

St. Louis Visits Wagner Electric

Members of the St. Louis Chapter Toured the Wagner Electric Corp. During a Recent Meeting. R. H. Hackett, vice-president in charge of manufacturing, presented a history of the company and described manufacturing operations at a meeting after the tour. Shown are, from left: R. C. Rueff, Nixdorff-Krein Manufacturing Co.; Willis Ehrhardt, Ehrhardt Tool & Machine Co., technical chairman; Mr. Hackett; and J. S. Skoglund, Lindberg Steel Treating Co. (Reported by David Murray for St. Louis)

Defines Hypnosis at Akron

Speaker: James Hodge

Akron Chapter's "Ladies' Night" was "sparked" by a talk on "Hypnosis", by James Hodge, who practices privately in Akron (Ohio). Dr. Hodge is associated with the American Psychiatric Association, the American Medical Association, the Society for Clinical and Experimental Hypnosis, and the Academy of Religion and Mental Health.

Dr. Hodge cited the dangers of hypnosis used for entertainment, saying that "stage hypnosis" can render hypnosis useless as a therapeutic tool by seeding fear of hypnosis among the public. They do this with demonstrations of "power" over the minds and will of men or with their claims to be able to cure illnesses, as if they possessed a "magic wand".

Skimming briefly the history of hypnosis, Dr. Hodge pointed out that it is as old as man himself; moreover, it was used in coniunction with major operations during the 18th Century. After being pushed from the limelight by modern anesthetics, hypnosis regained prominence during World War II when anesthetics were not always available.

Tackled next was the difficult problem of definition. Dr. Hodge elaborated on the fact that we do not actually know what hypnosis is; nevertheless, we know what it can do. Hypnosis may be thought of as a state of altered suggestability. It is a pleasurable state wherein the patient seems to be asleep, but is not. He is well aware of what goes on around him during his trance; moreover, the trance can be voluntarily terminated at any time by the patient himself. No one can be hypnotized against his will, hence, the unreliability of hypnosis. The number of people that can be effectively hypnotized is approximately 25 to 50%, and only 25 to 50% of these can be placed into a trance deep enough to be used as an anesthetic for an operation.

Dr. Hodge then explained some of the practical medical uses for hypnosis, which include asthma, ulcers, hiccoughs, nausea, bed-wetting and obstetrics.

Dr. Hodge's speech was concluded by a "lively" question and answer session.—**Reported by C. F. Moewe for Akron.**

Discusses Cobalt and Its Alloys

F. Rolf Morral, Who Directs the Activities of the Cobalt Information Center at Battelle Memorial Institute, Presented a Talk on "Cobalt and Its Alloys" at a Meeting Held by the Richmond Chapter. Shown are, from left: Dave Fenton, chairman of the membership committee; E. C. Taylor, vice-chairman; Dr. Morral; and T. S. Daugherty, treasurer of the chapter

Speaker: F. Rolf Morral

Cobalt Information Center
Battelle Memorial Institute

"Cobalt and Its Alloys" was the subject of a talk by F. Rolf Morral at a recent meeting of **Richmond Chapter.** Dr. Morral is a division consultant with Battelle Memorial Institute and directs the activities of the Cobalt Information Center.

A film, "Cobalt in Katanga", was used by Dr. Morral to illustrate production of cobalt from mine through smelter to final pig and shipment.

In the years immediately after World War II, there occurred a large increase in United States production of cobalt, largely due to increased demand for high-temperature alloys. Production rates were stepped up to the point that, at the present time, enough cobalt is available to supply nearly twice the present needs.

In 1958, approximately 30% of the cobalt used in the United States was for superalloys. Other uses and approximate amounts are: magnetic alloys (30%); alloying elements for steels (2.5%); nonmetals. (25%), and other (12.5%).

Cobalt-base alloys have interesting properties up to 1800° F., including good thermal shock resistance. These properties promote the use of cobalt alloys by the aircraft industry.

Dr. Morral briefly outlined the functions of the Cobalt Information Center, which include preparation and distribution of technical literature on cobalt and its alloys, direct assistance with specific problems and sponsorship of research to develop properties and applications of cobalt. **—Reported by W. W. Berkey for Richmond.**

Speaks on Wire and the Missile Age

Leaders at a Meeting Held by Worcester Chapter Included, From Left: Harold J. Holmes, Heald Machine Co., Vice-Chairman; Arthur L. Stowe, Vanadium Alloys Steel Co.; Chairman; Ronald E. Griffiths, American Steel & Wire Div., U. S. Steel Corp., Who Spoke on "Wire and the Missile Age"; and Kenneth H. Lever, Thompson Wire Co., Technical Chairman of the Meeting

Describes Application of Controlled Atmospheres At West Michigan Meeting

Speaker: C. A. Mueller

Lindberg Engineering Co.

Charles A. Mueller, director of the Gas Process Division, Lindberg Engineering Co., spoke on "Practical Application of Controlled Furnace Atmosphere" at a meeting of **West Michigan.**

Mr. Mueller first outlined the basic principle of controlled atmospheres and the primary reasons for using them; namely, minimizing scale and prevention of decarburization. He also discussed utilization of atmospheres to perform various operations, such as bright hardening of stainless steel, nitriding and carburizing.

The carbon content of the steel and the temperature required for heat treating dictate the dew point required to maintain equilibrium. Generally speaking, the higher the carbon content and temperature, the lower the dew point required for good atmosphere control.

The operating characteristics of different types of atmosphere generators were discussed. These included the older type charcoal generator, the exothermic generator and the more common currently used endothermic generator. It was explained that, in most cases, a high hydrogen atmosphere produced from dissociated ammonia can be used in place of cylinder hydrogen. A good example of the use of dissociated ammonia was given as the sodium hydride descaling bath which utilizes sodium pig and dissociated ammonia to produce sodium hydride. An interesting aspect of controlled atmospheres and one of current interest was the high-temperature carburizing process in the 1700-1850° F. range where increased case depths are achieved in far shorter time than in the past.

In the selection of furnaces for controlled atmosphere work, there are certain important features which should be considered, such as the capacity of the generator, furnace shell construction, choice of lining material and auxiliary handling equipment. Many types of controlled atmosphere furnaces were illustrated and their advantages and uses discussed. Among those shown were the "L" type, the conveyor type, the roller hearth and the rotary retort.

A question and answer period followed the talk with many interesting points being raised by the audience as to particular problems connected with controlled atmosphere furnace operations.—**Reported by Donald J. Gerken for West Michigan.**

Meet Your Chapter Chairman

NEW YORK

LESLIE L. SEIGLE was born in Dumbarton, Scotland. His chemical engineering degree is from Cooper Union Institute, his M.S. degree in metallurgy from University of Pennsylvania and D.Sc. degree in metallurgy from Massachusetts Institute of Technology. He has been associated with International Nickel Co., Inc., as research metallurgist in cast iron and steel and as project leader in the Thermodynamics Research Laboratory of the University of Pennsylvania. He later joined Sylvania Electric Atomic Energy Division as head of the fundamental metallurgy section and is now manager of the metallurgy research laboratory, Bayside, L. I. Mr. Seigle is also adjunct professor of metallurgy at New York University, teaching a course in mechanical properties of metals.

He is active in the A.I.M.E., having been chairman of the Physical Metallurgy Section, admissions and program committees and vice-chairman. He is also interested in local civic organizations.

Mr. Seigle plays the violin and keeps fit with gymnastics. He is married and has a son and daughter.

EASTERN NEW YORK

GARLAND W. REESE, JR., born in New York City, received his B.S. degree in metallurgical engineering at Rensselaer Polytechnic Institute. After college he worked for American Can Co. and Bergen Precision Casting Co. before joining Allegheny Ludlum Steel Corp., where he is now assistant general superintendent of melting. His particular specialty is extra-low-carbon stainless steel and other complex alloys. He received the Alfred H. Geisler Award given by the Eastern New York Chapter in 1958, for his work in the above.

Previous Chapter service includes chairman of the program, booklet and awards committees and vice-chairman. He is active in other technical, as well as civic organizations.

Mr. Reese served three years in the Infantry during World War II as a paratroop demolitionist. He has two children and enjoys fishing, photography and music.

MISSOURI SCHOOL OF MINES

With the aid of scholarships from American Society for Metals and the Foundry Educational Foundation and a Curators' Award, KENNETH I. PENDLETON expects to receive his B.S. degree in metallurgical engineering next June. During vacation months for the last three years he has worked at American Smelting and Refining Co., Omaha, LFM Manufacturing Co., Division of Rockwell, Inc., Atchison, Kan., and Beardsley and Piper, Chicago.

Chapter services include food chairman and treasurer. Kenneth is also president and corresponding secretary of Theta Tau professional engineering fraternity, vice-president, alumni secretary, steward and historian of Sigma Pi social fraternity and senior photographer of the Rollamo Board. He slips in a bit of fishing and hunting when he can. Church affiliation is First Christian.

EDMONTON

RICHARD ERIC HARDIE came to Canada in 1948 with Northwest Industries Ltd. as production superintendent. In 1954 he took his present position as assistant manager of Alta Bend, Ltd. Born in Birkenhead, England, Mr. Hardie completed his education at Bootle Technical College. His first positions were with Fairey Aviation Co. and Handley Page, Ltd. He was part of the Control Commission for Germany Disarmament and British delegate to Four-Power Committee (War Plants Bureau), Berlin, before coming to Canada. From 1940 to 1944 Mr. Hardie served in the Middlesex Regiment (H.G.).

He has been continuously active in Chapter work, serving on the entertainment committee, as secretary and vice-chairman. His recreational interests are soccer, cricket and tennis and he is interested in amateur dramatics and classical music. Daughter Jennifer is approaching her first birthday.

PEORIA

TRACY W. PECK was born in Nebo, Ill. After graduating from high school he entered an apprentice course at Caterpillar Tractor Co. During his 30 years there he has been a tool and die maker, tool heat treater and has held numerous jobs from foreman up to his present position of heat treat manager.

Mr. Peck has been a member of A.S.M. for 23 years. Before becoming chairman of the Chapter he served as program and education chairman and vice-chairman. He is also a member of the Society of Automotive Engineers.

Married and the father of three grown children, he is an ardent golfer as well as being interested in all other sports.

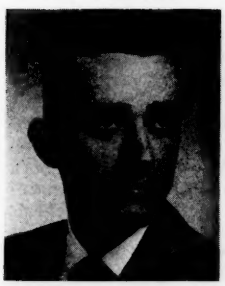
NORTHEAST PENNSYLVANIA

ROBERT L. WARD, a graduate of Rensselaer Polytechnic Institute, was born in Waterbury, Conn. After leaving college he joined Sylvania Electric Products, Towanda, Pa., as junior engineer. He is now product engineer.

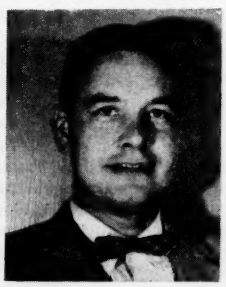
Previous Chapter services include chairman of the publicity committee and vice-chairman. He is also active in the Bradford County Industrial Management Club, Masonic organizations, P.T.A., and is past chairman of the Sylvania Employees Assoc., Chemical and Metallurgical Div.

Mr. Ward is a hunting enthusiast, being a member of the National Rifle Association and the Towanda Rifle and Pistol Club, and also likes to fish. He was first lieutenant in Army Ordnance for a year, is married and has a daughter.

K. I. Pendleton



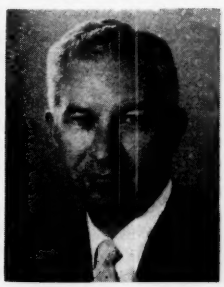
G. W. Reese, Jr.



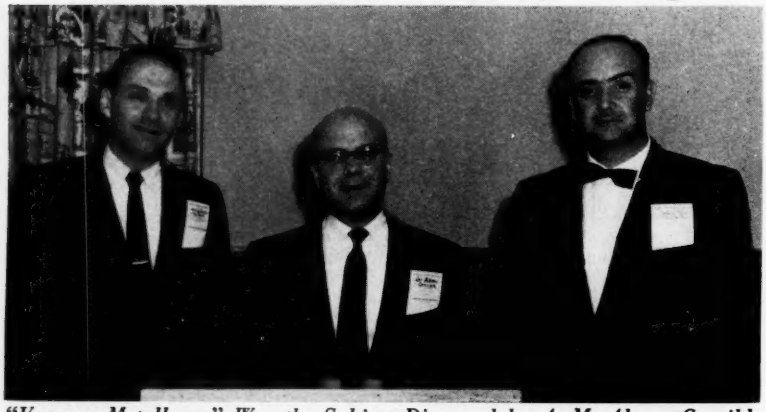
L. L. Seigle

R. E. Hardie

T. W. Peck



Vacuum Metallurgy Wilmington Topic



"Vacuum Metallurgy" Was the Subject Discussed by A. M. Aksoy, Crucible Steel Co., at a Meeting Held by the Wilmington Chapter. Shown are, from left: George E. Dieter, program chairman; Mr. Aksoy; and Sadun S. Tor

Speaker: A. M. Aksoy
Crucible Steel Co.

A. M. Aksoy, manager, Applied Research Laboratory, Crucible Steel Co., spoke on "Vacuum Metallurgy" at a meeting of the **Wilmington Chapter.**

Dr. Aksoy reviewed the history, present state and advantages of vacuum metallurgy. Demands for better materials, primarily by the aircraft and missile industry, have spurred increased research activities in the field of vacuum metallurgy during the past few years. Although vacuum metallurgy had its origin about 100 years ago, the first commercial-size vacuum furnace was not produced until 1923, when Heraeus in Germany built a unit capable of sustaining a vacuum of 5 mm. The progress made in various high-vacuum techniques during World War II benefited vacuum metallurgy very much.

Today several vacuum melting processes are available. The three main ones are: vacuum induction melting; vacuum arc melting, also known under the name of cold mold consumable electrode process, and vacuum degassing. Several other less important processes are vacuum skull, drip pool, zone, resistance, levitation and electrode bombardment melting. The above processes serve different purposes. The largest operation is vacuum degassing, which permits degassing of 250 tons of steel in about 4 hr. at a vacuum of 200-500 microns. Arc remelting permits melting of ingots up to 18,000 lb. maximum at 1-50 micron vacuum. Vacuum induction furnaces are capable of producing ingots of up to 5000 lb. maximum and permit continuous operation at a vacuum of 1-100 micron.

The purpose of vacuum metallurgy is to lower gas content, control composition of alloys more closely, improve cleanliness, obtain ingot structures free from central porosity and segregation and produce metals and alloys which cannot be melted economically by conventional techniques. Examples of alloys treated by the first four techniques are low-alloy steel, toolsteel and superalloy. Examples of alloys which cannot be produced economically by any other technique are iron-aluminum alloys, boron-stainless steels (2% B) and various superalloys such as Rene 41, Jetalloy, Waspalloy and Udimet 700.

The above techniques will improve various properties of alloys, such as workability, rupture strength at elevated temperature, elongation and reduction in area, fatigue properties and mortality rate in special applications, such as bearings.

Dr. Aksoy, who in 1958 visited Russia at the invitation of the U.S.S.R. Academy of Science, described various interesting studies conducted there on vacuum metallurgy. The Russians plan to desulphurize pig iron in the future by vacuum. Studies indicate that silicon lowers final sulphur content while manganese increases the rate of desulphurization under vacuum. The Russians are also studying rolling of refractory metals under vacuum of 10^{-5} mm. A small rolling mill, located in a vacuum chamber 5 ft. in diameter, was displayed by them. They are also making 100-lb. ingots melted in a vacuum induction furnace and poured into a mold radiated by ultrasonics, similar to the work done by Westinghouse.—**Reported by K. A. Semlak for Wilmington Chapter.**

Gives Talk on Magnetism And Magnetic Materials

Speaker: J. K. Stanley
Crucible Steel Co.

Rhode Island Chapter members heard a talk on "Magnetism and Magnetic Materials" by James K. Stanley. section manager, silicon steels, Technical Development Dept., Crucible Steel Co., and author of the A.S.M. book "Metallurgy and Magnetism".

Interest is rising in magnetic materials and uses are expected to increase manyfold in the next decade. This interest is shown by the increasing demands of the electronic industries in recent years.

Dr. Stanley covered theory and materials chronologically, from the pioneers, such as Oersted and Ampere, to the present electron spin theory and development of magnetic ceramics and new alloys with permeabilities and energy products in the millions.

The relatively new iron oxide ceramics are exemplified by the ferrites, both soft (high permeability) and hard (permanent magnets). A big use of soft ferrites today is for memory components in computers. This use takes advantage of their minimal eddy current losses, quick response to changing magnetic fields and their adaptability to high frequency uses. Other attractions are in iron-nickel alloys of low magnetostriction (change in dimensions with application of a magnetic field) and their low crystal anisotropy. The latter properties and characteristics, such as the shape of the hysteresis loop and permeability, can be controlled by the manufacturing techniques used.

Dr. Stanley spoke of the new doubly oriented silicon iron material, still in laboratory stages, which is produced by special rolling and heat treatment methods and has a preferred orientation of crystals in two directions 90° to each other. Magnetostriction phenomenon is typified by the energy-losing hum of transformers. The double orientation or "squaring" of the crystals in the silicon irons, coupled with further reduction of core losses, foretells real increases in electrical equipment efficiency.

Some of the new alloys for permanent or hard magnets were covered and mention was made of the recent Dutch announcement that an alloy has been developed with an energy product of 8.5×10^6 g-o as compared with the current value for Alnico V of 6.5×10^6 g-o. The energy product is a criterion for evaluating the strength of permanent magnets. The interesting presentation was concluded with an outline of means with which one can develop specific magnetic properties in both permanent and soft magnetic materials by physical, mechanical, chemical and metallurgical means.—**Reported by Edward D. Hyman for Rhode Island.**

Reports on Stainless in High-Temperature Service

Speaker: R. J. Raudebaugh
International Nickel Co., Inc.

The **Syracuse Chapter** recently heard a technical talk presented by R. J. Raudebaugh, International Nickel Co., Research and Development Division, on "The Applicability of Stainless Steels to High-Temperature Service".

Dr. Raudebaugh discussed types of stainless steels including three grades of the precipitation hardening alloys, namely, those solution treated and aged, those where a duplex treatment prior to aging is needed and those where the precipitation phase is formed in austenite.

Great interest was shown in a new alloy of the Fe-Ni system which was also briefly discussed. This alloy with 20-30% nickel, 2-3% total aluminum and/or titanium, 1% columbium and very low carbon, can develop a yield of 250,000-290,000 psi. with about 10% elongation in 1 in. With 6-7% aluminum and/or titanium a hardness of 67 Rockwell "C" can be attained.

Dr. Raudebaugh also briefly discussed cases of certain high-temperature corrosion phenomena that can take place under specific conditions. In particular, results of preliminary laboratory studies on the phenomena of metal dusting of iron-chromium-nickel alloys in carbon monoxide gas at about 1000° F. were described.—**Reported by G. Trojanowski for Syracuse Chapter.**

Speaks in Rockford on Explosive Forming of Metals

Speaker: Robert A. Cooley
Propellex Chemical Div.
Chromalloy Corp.

Members of the **Rockford Chapter** heard a talk on "Explosive Forming of Metals" by Robert A. Cooley, executive vice-president, Propellex Division, Chromalloy Corp. He described the early history, as early as 1888, when Monroe first controlled explosive energy on a workpiece and die. During World War II this idea of a shaped charge was used in the bazooka weapon to penetrate armor.

With the aid of slides Dr. Cooley defined and explained the types of explosive charges used to make cuts, bonds, blisters and various other forms. He noted the many difficult-to-form metals used in the aircraft and rocket industry and the application of explosive forming methods to produce the finished parts or mechanism. He indicated the important advantage of lower costs in this process, which does not require costly tooling and die work.

Dr. Cooley pointed out the various explosives available for many forming operations, and stated that the most extensively used are solid, plastic and liquid types. He described the die materials used in explosive forming and parts produced, such as the Jet 707 engine noise suppressors, turbine blades internally formed, tanks of various shapes and other parts. — **Reported by Glen W. Sandstrom for Rockford.**

Outlines Past and Future of Metallurgy

Cyril Stanley Smith, University of Chicago, Presented a Talk on the "Past and Future of Metallurgical Science" at a Meeting of the Chicago Chapter. Shown are, from left: L. F. Mandolpho, Illinois Institute of Technology; Dr. Smith; Carl H. Samans, national trustee A.S.M.; R. J. Hibbeln, chairman; and M. E. Fine, program chairman of the Chapter

Speaker: Cyril Stanley Smith
University of Chicago

Cyril Stanley Smith, University of Chicago, presented a talk on the "Past and Future of Metallurgical Science" at a meeting in **Chicago.**

The history of metallurgy dates back to about 3500 B. C. Early developments as an art were based on speculation and experience. They dealt mainly with smelting, working and composition. Although progress was slow, the achievements were outstanding. Most useful properties of metals and alloys were exploited in tools or jewelry before 2000 B. C.

The correlation between fibrous and facetted fractures in ductile or brittle alloys was probably observed very early in the Bronze Age. The earliest *record* of a structure is from about 500 B. C., in the form of Persian silver coins bearing on their backs the imprint of the fracture of a bronze bar which was used as a punch. Swords with a texture originating from the mixed forging of iron and steel were used in Europe before 200 A. D. and were made famous by the Vikings. The famed Damascus blades, which had a well-defined texture originating in dendritic segregation of high-carbon cast steel, were made by the Sixth Century A. D., probably much earlier. The superiority of oriental metallurgy over European was to a large extent due to the ability to follow structural changes in the surface pattern. The most effective of all swords were the Japanese ones, made by a process of repeatedly folding, welding and forging various layers of steel, the final surface being produced by a careful abrasive polishing to develop beautiful laminations or wood grain structures and to show the all-important *nioi* or line between martensite and pearlite after final heat treatment in a manner to produce a complicated gradient in cooling rate.

In the 17th Century the rebirth of Greek atomism produced much speculation on the properties of metals and their origin in a hypothetical structure. Reaumur, in 1722, first gave a good compositional and structural explanation of steel and its hardening, though carbon as such was not identified until 1774, when it played an important role in the chemical revolution.

As recently as a century ago fatigue failure of railroad axles could be attributed to crystallization of iron for it was not generally realized that the metal was always crystalline.

Modern metallurgical science grew primarily out of the studies of the microstructure of steel by Sorby, Tschernoff and Osmond from 1863 to 1885. Etching had been used earlier than this for quality control, but not to reveal crystallinity except in the case of meteorites where composition difference and crystallinity were associated. An entirely new period of activity occurred after the discovery of X-ray diffraction in 1912.

The metallurgical scientist of the future must perforce be a broader scientist than in the past for he must include nonmetals as well as metals and must know far more physics. He will continue to work with more complicated systems than are capable of complete analysis by the physicist, and perhaps will show the way to an entirely new science of complicated systems. — **Reported by W. L. Meinhart for Chicago.**

CHAPTER MEETING CALENDAR

Akron (Ohio)	**Jan. 20**	Sanginitis	**D. C. Smith**	High-Strength Welding
Baltimore	**Jan. 18**	Engineers Club	**M. Scheil**	Metal Failures Can Be Explained
Boston	**Jan. 8**	MIT Faculty Club	**John Haines**	Explosive Forming
Buffalo	**Jan. 14**	Continental Inn	**M. W. Herasimchuk**	Vacuum Degassing of Steel
Calumet	**Jan. 12**	Phil Smidt's	**Reynolds Metals Co.**	Growth of Aluminum in the Building of Industry
Chicago	**Jan. 11**	Prudential Bldg.	**Dana W. Smith**	Recent Developments in the Aluminum Industry
Chicago-Western	**Jan. 18**	Old Spinning Wheel	**Norman Hilberry**	Future of Nuclear Energy and Its Significance to Metallurgists
Cleveland	**Jan. 5**	N.A.S.A.		Plant Visit
Columbus (Ohio)	**Jan. 6**	Broad St. Christian Church	**Buford Sparks**	Structural Application of Beryllium
Dayton	**Jan. 13**	Engineers Club	**M. Humenik**	Better Cutting Tools in the Making
Delaware Valley (Penn.-N. J.)	**Jan. 20**		**Dave Holster**	Practical Maintenance Welding
Eastern New York	**Jan. 12**			What a Metallurgist Should Know About Corrosion
Fort Wayne	**Jan. 11**	Hobby Ranch House	**G. A. Warwick**	Control of Metallurgical Variables by Statistical Analysis
Golden Gate	**Jan. 4**	Spenger's Fish Grotto	**W. H. Rice**	Observations of a Metallurgist in Japan
Hartford	**Jan.**	Indian Hill Country Club	**Henry Hubbell**	Bearing Materials
Indianapolis	**Jan. 18**	Athenaeum	**B. D. Cullity**	Fundamentals of Phase Diagrams
Jackson (Mich.)	**Jan. 19**	Arbor Hills Country Club	**B. W. Gonser**	The Uncommon Metals
Kansas City	**Jan. 20**	Golden Ox	**Earl Parker**	Recent Developments in Materials Research
Long Island	**Jan. 20**	Patricia Murphy's	**H. T. Minden**	Semiconductors
Louisville	**Jan. 5**		**M. A. Scheil**	National Officers Night
Mahoning Valley	**Jan. 12**		**A. R. Troiano**	Hydrogen in Steel
Miami	**Jan. 11**	Woody's Steak House	**H. E. Renaud and W. D. Baker**	Plastics Used in Joining and Forming
Milwaukee	**Jan. 22**		**Social**	Winter Party
Montreal	**Jan. 4**	Queen's Hotel	**H. P. Godard**	Corrosion Prevention Starts With Design
Muncie	**Jan. 12**	Ball State Student Center	**G. H. Klouman**	Stainless Steel
New Haven	**Jan. 21**	Waverly Inn	**George Ratz**	Embrittlement of Metals
New Jersey	**Jan. 18**	Essex House	**I. S. Goodman**	Metallurgical Problems in Metal Joining
New York	**Jan. 4**	Brass Rail	**David Swann**	Fabricating With the Plasma Arc
N. E. Penn.	**Jan. 14**	Irem Temple Country Club	**K. L. Fetters**	New Developments in Steelmaking
North Texas	**Jan. 14**	Dallas	**Joint Meeting With A.S.M.E.**	The Cutting Edge
Oak Ridge	**Jan. 20**	K. of C. Hall	**K. H. Steigerwald**	Electron Beam Techniques
Ontario	**Jan. 8**	Beacon Motel	**R. C. Stewart, Moderator**	Stump the Experts Panel
Purdue	**Jan. 19**	Lafayette	**Bennett Kline**	Theory and Practice of Management
Philadelphia	**Jan. 29**	Engineers Club	**Panel**	High-Temperature Alloys
Phoenix	**Jan. 19**	Desert Rose Motel		Barrel Finishing
Pittsburgh	**Jan. 14**	Gateway Plaza	**Walter Crafts**	Facing the Productivity Challenge
Rhode Island	**Jan. 6**	Johnson's Hummock Grill	**L. M. Schettky**	Dimensional Stability of Metals
Richmond	**Jan. 12**	Downtown Club	**W. S. Pellini**	Application of Materials to Thermal and Space Flight Vehicles
Rochester	**Jan. 11**	Manger-Seneca Hotel	**D. J. McPherson**	Potentials and Problems of the Newer Metals
Rockford (Ill.)	**Jan. 27**	Hotel Faust	**F. R. Widmer**	How Foreign Steels Are Affecting Economy of the U. S.
Saginaw Valley (Mich.)	**Jan. 12**	High Life Inn	**Kenneth Meade**	Science and Education in High Schools and Universities Today
St. Louis	**Jan. 21**		**Glen Dilling**	Tooling and Production
Syracuse	**Jan. 5**	Onondaga Hotel	**Joint Meeting With A.I.Ch.E.**	
Texas	**Jan. 5**		**C. P. Larrabee**	Natural Media Corrosion of Ferrous Metals
Toledo	**Jan. 21**	Maumee River Yacht Club	**C. E. Beta**	Magnetic Particle Inspection
Tri-City (Ill.)	**Jan. 12**	Hotel Blackhawk	**M. A. Scheil**	Metal Failures Can Be Explained
Tulsa	**Jan. 5**	Alvin Plaza Hotel	**Panel**	Nondestructive Testing
Washington	**Jan. 18**	All States Hotel	**Morris Tannenbaum**	Metallurgy in Electronics
West Michigan	**Jan. 18**	Scottie's Restaurant	**A. E. Focke**	The Metallurgist and the Metals Industry
Wilmington	**Jan. 13**	Fabian's Restaurant	**F. G. Tatnall**	Metallurgy and Engineering
Worcester	**Jan. 13**	Hickory House	**H. Johnstin and E. Bancroft**	High-Speed Steels
York	**Jan. 13**	York	**E. S. Rowland**	Practical Applications of Physical Metallurgy

EMPLOYMENT SERVICE BUREAU

The Employment Service Bureau is operated as a service to members of the American Society for Metals and no charge is made for advertising insertions. The "Positions Wanted" column, however, is restricted to members in good standing of the A.S.M. Ads are limited to 50 words and only one insertion of any one ad. Address answers: c/o A.S.M., Metals Park, Novelty, Ohio, unless otherwise stated.

POSITIONS OPEN

East

MATERIALS AND PROCESS ENGINEERS: Openings for college graduates, or men with three to five years experience. Metallurgical and chemical engineers preferred, consideration to mechanical or aeronautical. Send resume to: M. F. McFadden, Head, Materials & Process Specifications Section, Raytheon Co., Missile Systems Div., Bedford, Mass.

METALLURGIST-PHYSICIST: Major producer of small-diameter tubing has opening for graduate metallurgist or physicist with minimum of one to two years experience, preferably in field of nondestructive testing. Participation will be in development of eddy current methods, ultrasonic tests and other instrument applications. Send resume and salary desired. Box 12-5.

METALLURGIST OR CHEMICAL ENGINEER: Recent graduate to work in research and development on projects concerned with new or improved products or processes. Involves metallurgical development work in the laboratory and pilot-plant stage, keep records and make reports. Interest in both ferrous and nonferrous metals important. Send resume and salary requirements to: J. A. Turner, John A. Roebling's Sons Div., Colorado Fuel and Iron Corp., 640 S. Broad St., Trenton 2, N. J.

PLANT SUPERINTENDENT: Knowledge of fabrication, machining, drawing interpretations, management techniques. Working knowledge of industrial engineering, production control and union contract administration. Three to four years experience in steel fabrication operations. Engineering or equivalent college degree required, with minimum of ten years supervisory experience. TOOL DESIGN ENGINEER: To design and develop jigs, fixtures, gages and special tooling. Experience in analysis of final designs, capable of selecting suitable materials and checking supplemental designs prepared by others. B.S. degree in mechanical engineering with minimum of five years experience in tool design. PRODUCT MECHANICAL ENGINEER: To develop, calculate and design mechanical features of products. Knowledge of mechanical design, strength of materials, material selection and code requirements. B.S. degree with background in heat transfer, fluid flow and mechanical design. Two to three years experience in mechanical design of equipment. STRESS ANALYST: To prepare stress analysis analytical investigations. B.S. degree in mechanical engineering, knowledge of engineering practices, mechanical design, strength of materials, properties, governmental and regulatory codes. Casual knowledge of heat transfer and fluid flow. WELDING DEVELOPMENT ENGINEER: To supervise welding development research projects, investigate fabrication welding problems and prepare research reports. B.S. degree in welding or metallurgical engineering. All above located in Dunkirk, N. Y. Send resumes and salary requirements to: G. Y. Taylor, Administrative Services, Alco Products, Inc., Schenectady 5, N. Y.

STEEL RESEARCH METALLURGIST: To conduct research and development projects in alloy steel in new modern laboratory. Knowledge of laboratory electric steel melting techniques and knowledge of methods of analysis and examination and testing of experimental alloys essential. At least five years melting practice closely allied with research and development programs required. Advanced degree, preferably Ph.D., desirable but not necessary. Location: Latrobe, Pa. Send resume and salary requirements in confidence to: G. Y. Taylor, Administrative Services, Alco Products, Inc., Schenectady 5, N. Y.

METALLURGICAL ENGINEER: With at least five years experience in wire drawing of stainless steels and related alloys, needed by manufacturer in Northern New Jersey area. Send complete record. Box 12-140.

METALLURGICAL ENGINEER: In Newark, N. J., area, with at least five years experience in cold rolling of stainless steels and related alloys. Send complete record. Box 12-145.

METALLURGISTS: Graduate, with up to three years experience. Work in quality control laboratories of well-known aircraft forging company. Materials from light metals, titanium through high-temperature and refractory. Diversified metallurgical problems including development work on effect of forging variables and heat treatments on room and elevated-temperature properties of various alloys. Box 12-195.

METALLURGISTS: B.S. degree. Recent graduates with up to three years experience preferred. Duties would include supervision of applied research on projects related to nonferrous investment castings. Plant located in New England. Salary commensurate with qualifications. Box 12-155.

Midwest

SALES ENGINEER: Cleveland territory open for experienced sales engineer for nickel chromium electrical resistance wire and other nickel alloy wire, rod and strip and stainless steels. Good opportunities for above average income and advanced responsibilities with progressive company. Salary and incentive program. Please send complete resume. Box 12-10.

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CONSULTANT: Rapidly growing management consulting organization requires capable, young consultant with successful experience recruiting executives (over $20,000 per year salary level) for industrial organizations. Major emphasis on scientific and technical personnel. Management engineering background required. Attractive location and compensation features for the right person ($15,000 to 20,000.) Equity opportunity possible. Our employees know of this opening. Box 12-15.

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Production Supervisor—Rolled Products

The position requires the daily supervision of the rolling and finishing areas. The rolling area consists of multi-purpose rolling facilities, unique in design, and capable of very diversified operations. Both hot and cold rolling of sheet, bars and coils of refractory metals will be involved. Experience in finishing, heat-treating and inspection is essential.

Production Supervisor—Melting

The position requires previous experience in consumable electrode-cold mold-arc melting operations. In addition, thorough knowledge of electrode preparation and the behavior of refractory metals on melting and solidification is required.

Trained personnel in physical and mechanical metallurgy or those with equivalent experience are needed for these supervisory openings. Please forward resume, including details of education, experience and salary expected to Mr. A. F. Hartford, Employee Relations Department, E. I. du Pont de Nemours & Company, Wilmington, Delaware. Replies held confidential.

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The J&L Research Division is housed in the modern, air-conditioned, fully-equipped Graham Laboratory in suburban Pittsburgh. Attractive residential areas are close by. And progressive Pittsburgh offers many advantages, including full graduate programs at the University of Pittsburgh and Carnegie Institute of Technology for the man who wants to continue his professional education.

If you have these interests, we would like to hear from you, and will respect your confidence. Write.

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Production metallurgical or quality control experience desirable.

Salary commensurate with qualifications.

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Southern California Commercial Heat Treating Plant requires General Superintendent with metallurgical engineering background. Must be thoroughly experienced in operation and maintenance of heat treating furnaces (pit, batch, and salt bath-type), induction hardening equipment, atmosphere generators, cleaning equipment, etc. Must be able to set up processing specifications and schedule work thru plant. Excellent working conditions and exceptional plant facilities. Position offers excellent opportunity for qualified man. Send complete resume stating age, marital status, health, education, past work experience and salary requirements.

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Columbus 1, Ohio

producing processes, rolling mills and product physical metallurgy. B.S. degree required. If you desire a challenging assignment with an opportunity for professional growth and advancement, send complete resume. Box 12-20.

PHYSICAL METALLURGIST: Opportunity in large Western Pennsylvania research and development organization for recent B.S. or M.S. graduate having sound educational background in physical metallurgy to work on silicon steels for electrical sheets. Applicants with knowledge of X-ray diffraction and crystallography preferred. Experience desirable but not essential. Reply, giving complete information and salary requirements. Box 12-25.

SALESMAN AND DISTRICT MANAGER: Excellent opportunity for salesman and district manager in Chicago territory with manufacturer of nickel chromium electrical resistance alloys, high-nickel alloys and stainless steels. Send complete resume. Box 12-30.

PHYSICAL METALLURGIST: B.S. in metallurgy with two to five years experience, to work in engineering department of automotive company on ferrous and nonferrous alloys in developing material applications, material specifications, physical testing, part failure analysis, metallography and heat treatment. Salary open. Write: A. H. Rodenbeck, International Harvester Co., Motor Truck Engineering Dept., Fort Wayne, Ind.

METALLURGIST: Metallurgical degree and three or more years experience in die casting of zinc and aluminum. An excellent opportunity for a capable man to show his ability with excellent opportunities for advancement. Send complete resume to: Lee Skillman, Doehler-Jarvis Div., National Lead Co., Toledo 1, Ohio.

RESEARCH METALLURGIST: Metallurgical degree and three to eight years experience in nonferrous and/or toolsteel metallurgy. Should be able to plan and conduct research investigations on a wide variety of metallurgical problems relating to die castings. Send complete resume to: Lee Skillman, Doehler-Jarvis Div., National Lead Co., Toledo 1, Ohio.

SALES ENGINEER: To handle pneumatic comparator gages. Graduate preferred although experience in industrial sales or field of quality control could qualify man with at least two years engineering college. Salary range $500-550 per month. Contact: Moore Products Co., 25000 Euclid Ave., Cleveland 17, Ohio, or call Cleveland AN 1-2250.

METALLURGIST: Young B.S., for toolsteel mill metallurgy leading into general metallurgical work in this field. Prior steel mill or toolsteel experience desired but not essential. No melting experience required. Location in Pittsburgh area. Salary open. Send resume. Box 12-155.

MANUFACTURER'S REPRESENTATIVE: For sale and distribution of electronic beam welding, smelting and zone refining equipment, as well as vacuum digital gages for direct reading and recording. Electronic beam equipment operates on low voltage, is radiation free, economical and moderately priced. For details, write: Nuclear Metallurgical Enterprises, Inc., 1004 United Office Bldg., Niagara Falls, N. Y.

METALLURGICAL ENGINEER: Graduate. Experience in low-alloy and austenitic high-temperature alloys preferred, but will consider recent graduate. Assignment in process control laboratory of major automotive parts manufacturer. Work covers forging, cold forming, heat treating methods. $6500/9600. Cleveland area. Box 12-160.

Southwest

METALLURGIST: B.S. degree in metallurgy required, M.S. degree preferred. Experience in heat treat, carburizing and general ferrous metallurgy required. Work will be on both developmental and research type projects at Houston plant. Salary open depending upon qualifications. Write: Personnel Dept., Reed Roller Bit Co., P. O. Box 2119, Houston, Tex.

MECHANICAL ENGINEER: For air cooled heat exchangers. B.S. in mechanical engineering with practical experience required. Location: Beaumont, Tex. Send resume and salary requirements in confidence to: G. Y. Taylor, Administrative Services, Alco Products, Inc., Schenectady 5, N. Y.

Government

U. S. Civil Service Commission wants qualified scientists in the fields of metallurgy, chemistry, mathematics and physics for research work in the Washington, D. C., area, to work with some of nation's foremost scientists in attractive and promising assignments with outstanding opportunities for advancement. Entrance salaries from $4490 to $12,770.

Most appointments are made to National Bureau of Standards, Dept. of the Air Force, Agricultural Research Service, Walter Reed Army Medical Center, Diamond Ordnance Fuze Laboratories, Geological Survey, Bureau of Mines, Food and Drug Administration, National Institutes of Health. Basic and applied research is highly diversified and affords challenges in physical science field.

Candidates must have completed appropriate college study leading to a bachelor's degree. In addition, for positions paying $5430 and above, graduate study or professional experience is required. College graduates may also qualify for positions paying a beginning salary of $5340 a year if they have a superior scholastic record or by passing an appropriate written test.

Further information is contained in Civil Service Announcements 209B and 210B, available at many post offices or from the U. S. Civil Service Commission, Washington 25, D. C. Applications will be accepted by the Board of U. S. Civil Service Examiners, National Bureau of Standards, Washington 25, D. C., until further notice.

POSITIONS WANTED

EXECUTIVE ENGINEER: Internationally known metallurgical and welding engineer with 23 years experience in steel mill, process equipment, boiler and atomic energy components. Has held executive positions in metallurgical, welding, quality control and manufacturing. M.S. degree. Age 45. Has leadership, drive, is respected in industry and community, active in technical organizations. Qualifies for position as director of metallurgy, manager of quality control, plant manager or assistant to president. Interested in five figures with growth opportunities. Box 12-35.

MACHINE DESIGNER: Age 41, now chief designer for small company, strong record in development of oil-well servicing equipment. Requires project or departmental responsibility. Location Southwest. Box 12-40.

METALLURGIST: Desires sales or technical service position. Research and development background. Excellent academic training. Young, single, free to relocate, free to travel. Box 12-45.

METALLURGIST: Age 38. Diversified plant metallurgical experience of nine years, plus three years sales engineering in heat treating field. Ferrous and nonferrous in nondefense

METALLURGISTS

Excellent opportunity to grow with a progressive expanding company for graduates with B.S. degree and up to five years experience, to carry out work in laboratory programs on extraction, alloying, melting, extrusion, welding, rolling.

Salary commensurate with qualifications and experience.

Send resumes in confidence or call collect—

Richard M. Quimby,
Personnel Director
The Beryllium Corp.
P. O. Box 1462
Reading, Pa.

METALLURGIST

Fine opportunity in well-equipped lab of large metal fabricator. Development and trouble-shooting work in ferrous metallurgy primarily. Experience required, degree preferred. Send complete resume including salary requirement to:

Personnel Department
The Stanley Works
New Britain, Conn.

Research Metallurgist

Opening for Physical or Mechanical Metallurgist for research and development of materials and processes for mass production.

Well equipped laboratory, competitive salary and full G-E benefits.

Advanced degree with 3 or more years appropriate experience preferred.

Replies will be held in confidence. Write to:
Mr. E. F. Shell

MAJOR APPLIANCE DIVISION

GENERAL ELECTRIC

Appliance Park Louisville, Kentucky

TECHNICAL SERVICE ADVISOR

Interesting & Diversified Duties

for young man who is 29 or under . . . has B.S. (Engineering or Science) with metallurgical and/or chemical background or experience related to metal-treating . . . evidences strong maturity in order to deal with important customer representatives . . . (special emphasis here if experience is lacking). Healthy, expanding, separate division of national concern, position headquarters—Chicago. Development of new business as important as servicing current accounts. Please write background including salary requirements to

Box 12-115, Metals Review

ENGINEER-SALES

For magnesium Alloy extruded & rolled products in middle Atlantic States, good salary, expense account, pension & insurance. Secure, stable position for right man with well established Company. Write giving background to C. E. LARSON, White Metal Rolling & Stamping Corp., 80 Moultrie St., Brooklyn 22, N. Y.

METALLURGIST

Prominent medium-sized manufacturing concern, working primarily in the missile industry, has an opening for an experienced metallurgist. This is a permanent position requiring heavy responsibility and independent judgment. It offers excellent pay, good employee benefits and an opportunity for the future. Plant is located in the San Diego, Cal., area.

Requires 5 to 10 years aircraft or missile experience along with at least a Master's degree in metallurgy from an accredited college. Salary open, send resume, including salary required to:

Charles R. Swaim
790 Greenfield Drive
El Cajon, California

Fuel and Materials Development

Senior Metallurgist, Physical Chemists and Engineers

Reactor Materials. Research involves investigation and analysis of mechanical and physical properties of metallic alloys and inter-metallic compounds. Materials are to be used in power reactors for fuel, and fuel cladding, moderators, control rods, and structural members. Studies will include analysis of materials after exposure to high temperatures and radiation fields.

Fuel Element Engineering. Responsible for the complete analysis and design of fuel elements. This includes nuclear, thermal, material, mechanical and cost analyses. Should be familiar with fuel life determination methods and reprocessing techniques.

Fuel Fabrication. Activities will include development fabrication of materials and fuel elements, for both plate and rod forms and complex assemblies. A knowledge of non-destructive testing methods is essential, in addition to familiarity with a wide range of material processing and fabrication techniques.

Irradiation Experimentation and Hot Lab Evaluation. Senior Research Engineers and Physicists are required to design and conduct irradiation experiments on developmental materials including reactor fuels. The individuals must be familiar with a wide range of radiation and temperature conditions. Experimental conditions will include the simulation of conditions expected in full scale power reactors. Also senior personnel are needed to develop equipment and techniques required for the post-irradiation testing and evaluation of these experiments.

For specific details write:
Mr. D.M. Newton, Personnel Office, Atomics International, 21600 Vanowen Street, Canoga Park, California.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.

speciality and high production. Good organizer and economist. Has initiative, imagination and deals well with others. Box 12-50.

METALLURGICAL ENGINEER: B.S. degree, registered engineer, with 19 years diversified experience in steel mill, forging, foundry, automotive, aircraft and missile fields. Desires management position in technical or service organization, ferrous or nonferrous. Box 12-55.

PHYSICAL METALLURGIST, RESEARCH METALLOGRAPHER: Age 28, married. Experienced in nuclear metallurgy research. Publications. Desires position in research and development laboratory. Location not a factor. Resume sent on request. Box 12-60.

METALLURGICAL ENGINEER: B.S., M.S. degrees, age 34, married, family. Twelve years supervisory experience includes almost all phases of manufacturing, product engineering and research and development. Desires managerial position with growth potential in New England. Resume on request. Box 12-65.

METALLURGICAL ENGINEER: B.S. degree, age 30, married, graduate studies in metallurgical engineering. Six years experience in research and development in refractory metals, ceramics, superalloys, and related ferrous and nonferrous metals. Extensive experience in heat treatment, flame spraying, materials and processing specifications. Seeks responsible leadership position with West Coast or foreign company actively interested in developing and evaluating new material combinations and new processing methods. Box 12-70.

HEAT TREATING TECHNICIAN: Tool-steel products, with 25 years diveraified practical and text-book learning experience (no degree) wishes affiliation with employer interested primarily in availing self of benefits of practical, theoretical, problem solutions, reporting technical-reporting and liaison capabilities offered. Will relocate and/or travel anywhere. Resume on request. Box 12-75.

PHYSICAL METALLURGIST: Ph.D. degree, eight years research, teaching and supervisory experience in problems associated with mechanical metallurgy, high-temperature and reactive metals. Desires challenging position in research or development, greater New York area. Age 30, married. Box 12-80.

METALLURGICAL ENGINEER: M.B.A. degree in marketing, B.S. in metallurgy. Experience in metallurgical research, material specifications, steel manufacturing, marketing research. Desires position in some phase of marketing, including sales. Resume sent on request. Box 12-85.

METALLURGIST: B.S. and A.B. degrees. Experience includes metallurgist, quality control with aircraft, technical assistant in metallurgy, guided missiles, research technician in powder metallurgy on cemented carbides. Experienced in metallography, trouble shooting, specifications, failure analysis, technical reports. Desires position as physical metallurgist. Age 32, married, veteran. Available immediately. Reasonable. Now in East, willing to relocate. Box 12-90.

METALLURGICAL ENGINEER: B.S. degree, age 34, veteran, family. Three years research experience with wrought and cast stainless steels and high-temperature alloys. Six years experience in high-production gray iron foundries as melting supervisor and metallurgist. Interested in career position with industrial concern. Resume on request. Box 12-95.

MELT SHOP METALLURGIST: Veteran, degrees in metallurgical engineering and business administration, background in melting and initial fabrication of high-temperature alloys, stainless steels and pH alloys. Position desired in production metallurgy in ferrous industry or related field. Minimum salary $10,000. Box 12-100.

MANAGEMENT-LEVEL ENGINEER: Age 40, M.E., M.S. degrees in metallurgy. Qualified administrator. Diversified and intensive experience in fabrication, heat treatments, welding, brazing of stainless, carbon, alloy steels; copper, nickel alloys; refractory metals. Desires management position with medium-size company in quality control, engineering or production. Prefers New England. Box 12-105.

METALLURGIST: B.S. in metallurgy, Penn State, 1959, completing six-month Army program in February, desires job in steel producing company in Baltimore-Washington area. Box 12-110.

SALES ENGINEER: Toolsteel, investment castings or high-temperature alloys. B.S. in chemical engineering plus metallurgy. Age 42. Research and development experience for six years, plant metallurgist and materials engineer for 14 years. Some sales experience. Location in Northeast Ohio. Box 12-165.

FORGED ROLL MANAGER—EXECUTIVE ENGINEER: B.S. in chemical engineering, registered metallurgical engineer. Fifteen years experience in all phases of forged roll manufacture, eight years as project manager for both engineering and operating companies in connection with new chemical and metallurgical facilities. Available in 30 days for position of responsibility. $15,000 minimum. Box 12-170.

METALLURGIST: M.S. degree, age 36, married. Eight years experience in research and development, four years in investigation of mechanical behavior of steel, two years in investigations of low-temperature behavior of ferrous alloys, two years in high-temperature alloys. Desires position with future in research and development. Will relocate. Box 12-175.

METALLURGIST: Age 46, B.S. degree, married. Recent heat treating and fabrication experience in treatment of high-strength and corrosion-resistant steels in aircraft. Extensive experience managing commercial heat treating plants for 14 years. Formerly chief metallurgist for large aircraft plant. Good background in all phases of heat treating and knowledge of metals. Will relocate. Box 12-180.

METALLURGICAL ENGINEER: B.S. in metallurgical engineering. Two years experience in integrated steel mill, five years in research and development of titanium and zirconium, two and one-half years process engineering titanium. Interested in titanium, zirconium and high-temperature metals. Location Midwest, West or Southwest. Box 12-185.

METALLURGICAL ENGINEER: B. Met. E. degree, age 24, married, family. Eight months experience in aluminum reduction plant operations. Two years as Air Force armament and electronics officer. Desires position in production, development or research. Available after March 1960. Box 12-190.

METALLURGIST

Outstanding opportunity for a Metallurgist interested in a career with an appliance manufacturing leader located in the midwest. Product engineering assignments will involve development of new processes and applications of metals for use in major appliances. Salary open. Outstanding benefit plans; a genuine career opportunity. Send resume and salary requirements to:

Box 12-125, Metals Review

OPENING FOR QUALIFIED PERSONNEL

Large Steel Foundry, located in Michigan, urgently in need of qualified personnel with experience in investment and ceramic molding. Metallurgical experience a necessity. Write giving full resume.

Box 12-120, Metals Review

MAKE A DATE FOR DALLAS

Second Southwestern Metal Exposition and Congress Will be Held in

Dallas . . .

May 9-13, 1960

METALLURGY

Opportunities In Advanced Reactor Development. The new groups being formed around key members of The Knolls Atomic Power Laboratory's professional staff afford metallurgists who join us now, unusual opportunities to work in close liaison with acknowledged leaders in reactor technology. You are invited to inquire about current openings in: **Materials Application.** Initiate and execute R&D programs of nuclear materials. BS in Metallurgical Engineering or Chemistry. **Fuel Element Materials.** To conduct development investigations in area of fuel element materials. Should have MS or PhD in Metallurgy and 3-10 years related experience or PhD in Physical Chemistry. **Process Metallurgy.** Prepare programs and recommend compatible metallurgical systems and processes to obtain low-cost, high endurance nuclear fuels. Should have BS in Metallurgical Engineering and 2-5 years related experience. **Welding.** To initiate, conduct and evaluate program on weldability of materials and suitability of joining processes. BS in Metallurgical Engineering or ME. **Ceramic Materials Development.** Perform development investigations in the area of ceramic fuel element materials. Qualifications should include PhD in Ceramics and up to 3 years experience in applied ceramics. **Quality Assurance.** Act to assure adherence to process of quality requirements during fabrication of nuclear fuels and cores; provide technical leadership for field inspectors. Should have BS in Met E, Chem. Physics or Chem E with 5-10 years manufacturing experience, primarily in quality control.

Also Openings in: X-Ray Diffraction / Physical Chemistry / Metallography / Irradiations Engineering / Vacuum Techniques

U.S. Citizenship Required / Please send your resume in confidence, including salary requirement, to Mr. A. J. Scipione, Dept. 43-ML.

Knolls Atomic Power Laboratory

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SCHENECTADY, N. Y.

Metallurgists examine

What happens to zirconium alloys when they are subjected to double arc melting procedures . . . or, what are the effects on the volatile impurity content of Zircaloy-2 when furnace pressure is varied?

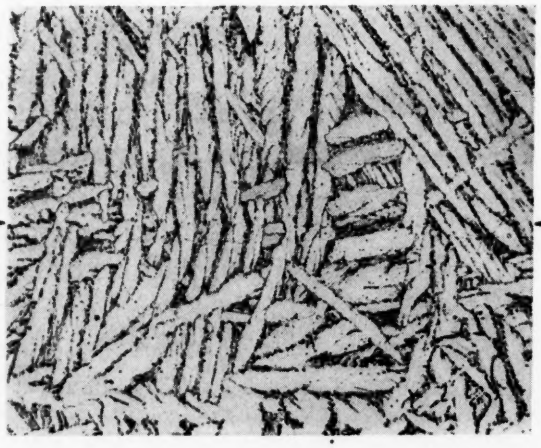
These are some of the basic fabrication questions under investigation at the Bettis Atomic Power Laboratory where metallurgists are involved in a dynamic experimental and applied reactor metallurgy program which includes the development of new fuel material, radiation studies, new types of cladding and the application of existing materials to nuclear systems.

NEW FABRICATION TECHNIQUES

If you are a metallurgist and are interested in pursuing a career in reactor and nuclear system metallurgy and are a U.S. citizen, write to: Mr. M. J. Downey, Dept. B-18, Bettis Atomic Power Laboratory, Westinghouse Electric Corporation, P.O. Box 1526, Pittsburgh 30, Pennsylvania.

Bond Line

Joining Zirconium to Zirconium by Eutectic Diffusion Bonding



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